Pharmacy School Cost and Opioid Dispensing: A Hidden Connection?

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Abstract

The opioid crisis in the United States has reached unprecedented levels, but little is known about the role of pharmacists. Using large-scale data on pharmacists' online job profiles and data on college tuition, we investigate how the cost of pharmacy education impacts pharmacists' career choices and their subsequent opioid dispensing practices after graduation. Specifically, we compare opioid dispensing quantities across pharmacists from institutions in the same county but with different tuition costs. First, we show that pharmacies with higher levels of opioid dispensing offer higher wages. Second, we find that pharmacists from higher-tuition institutions are more likely to work at pharmacies with higher opioid dispensing. Lastly, we demonstrate that the positive relationship between pharmacy education costs and opioid dispensing is stronger among pharmacists who are in their first two years post-graduation, male pharmacists, and those working in areas with more severe prescription opioid use. Our findings indicate that pharmacists from institutions with higher tuition, who likely face greater student debt, may be more inclined to work at pharmacies that dispense larger quantities of opioids due to financial concerns.

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1 Introduction

The United States is experiencing the worst opioid epidemic in its history,[1] with devastating impacts on public health, communities, and the economy. While previous studies have highlighted that physicians and pharmaceutical distributors have played major roles in the crisis, relatively less attention has been paid to the role of community pharmacies and pharmacists. Over the past decade, multiple lawsuits have been filed against major pharmacy chains, including Walgreens, CVS, and Walmart.[2] These lawsuits claimed that pharmacies have played a key role, primarily through improper dispensing and failure to monitor suspicious opioid orders.[3] Although there is growing attention on the causes of these improper dispensing practices, there is still limited understanding of the factors influencing pharmacists' dispensing behavior.

In this paper, we examine whether financial motivations among pharmacists may contribute to their opioid dispensing practices. Specifically, we investigate whether pharmacists who attended pharmacy schools with higher education costs are more likely to work in pharmacies that dispense greater quantities of opioids after graduation. We hypothesize that the financial pressure of repaying student debt may drive pharmacists to seek employment at pharmacies with higher opioid sales, where the financial rewards are potentially greater.

However, investigating the link between educational costs for pharmacists and opioid dispensing behavior is empirically challenging mainly due to data limitations. Such an analysis would require comprehensive information on pharmacists' education, associated tuition costs, the pharmacies where they are employed after graduation, and the opioid dispensing patterns at those pharmacies, which are not generally available in the U.S.

We overcome the data challenge by constructing a novel dataset that links large-scale worker-level online job profile data with college education costs and pharmacy-level opioid dispensing data. Our data are from three primary sources. First, Lightcast provides detailed job

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[2] These lawsuits claim that the pharmacy chains failed to implement adequate systems to detect and report suspicious orders of opioids, violating their legal obligation to prevent the diversion of controlled substances for illicit use. The allegations focus on how these pharmacies prioritized profit over safety, dispensing opioids in high quantities without addressing red flags such as repetitive prescriptions, excessive dosages, or prescriptions from questionable sources.

[3] The lawsuits alleged that the chains did not implement adequate systems to detect and report suspicious opioid orders, violating their obligations under the Controlled Substances Act. These settlements amounted to billions of dollars, with the funds directed toward addressing the damage caused by the opioid crisis, including treatment and prevention efforts.

and education information for U.S. pharmacists by compiling longitudinal job histories from online career platforms, capturing both worker and job-level characteristics. Second, the College Scorecard offers comprehensive data on higher education institutions, including tuition, fees, and completion rates. We use this dataset to estimate the expected college costs for pharmacists. Lastly, the DEA's ARCOS data provide information on pharmacy-level opioid dispensing over time.[4] For each pharmacist in the Lightcast data, we link information on college education costs and opioid dispensing using information on the schools they graduated from and the pharmacies where they are employed. This allows us to create a comprehensive dataset on pharmacists' education, associated tuition fees, and their subsequent employment and opioid dispensing practices. Our final sample consists of 13,563 pharmacists who worked at an opioid-dispensing pharmacy at some point between 2006 and 2019. Our final sample consists of 13,563 pharmacists who worked at opioid-dispensing pharmacies at any point between 2006 and 2019, representing approximately 10

We begin by demonstrating a positive correlation between opioid sales and wages offered at the pharmacy level, suggesting that this may be a key factor motivating pharmacists with higher education costs to seek employment in these pharmacies.[5] Recent studies further support the idea that higher opioid sales may be linked to both negative work environments and increased compensation for pharmacists (Chiu et al., 2023). For instance, documents from the pharmaceutical industry, released during litigation between 1997 and 2020, reveal that pharmacists were often pressured by managers to fill more opioid prescriptions. This pressure was tied to managerial incentives, as higher prescription volumes were associated with higher store revenues and higher managerial compensation. Moreover, pharmacists who refused to fill opioid prescriptions in good faith often faced a negative work environment created by their managers. Our findings, which show higher wages for pharmacists in pharmacies with higher opioid dispensing rates, provide indirect evidence that financial incentives may be contributing to these dynamics.

To examine the relationship between higher college costs and employment at pharmacies that dispense more opioids, we estimate the relationship between college costs and opioid sales at the

[4] XXX Why we focus on oxycodone XXX

[5] We use data from [XXX] to support this analysis.

pharmacy level, controlling for various individual, college, and pharmacy characteristics, following the approach suggested in Schnell and Currie (2018). Our empirical strategy also addresses potential confounding factors, such as the possibility that pharmacists may have sorted into certain pharmacy schools or pharmacies based on their predisposition towards opioid dispensing or local demand for opioids.

We find a positive association between college costs and opioid sales during a pharmacist's career. Specifically, pharmacists who attended colleges with higher tuition costs tend to work at pharmacies that sell more opioids, as shown by a clear gradient in oxycodone sales across different college cost groups. For example, pharmacists from the highest tuition colleges sell about 2.5 times more opioids than those from the lowest tuition colleges. The elasticity estimates further support this relationship, indicating that a 1% increase in expected tuition and fees is associated with a 1.45% increase in opioid sales. This association persists even after controlling for various factors, such as pharmacist skills and local opioid exposure, suggesting that college costs may play a role in shaping pharmacists' career choices, potentially leading them to seek employment at pharmacies that engage in higher levels of opioid dispensing. Robustness checks and additional analyses confirm the consistency of these findings across different specifications.

Our study contributes to the extensive body of work examining the causes and consequences of the opioid crisis, which has analyzed the roles of opioid policies (Alpert et al., 2018), physicians (Eichmeyer and Zhang, 2022), manufacturers (Alpert et al., 2022), and insurers in fueling the epidemic, as thoroughly reviewed in Maclean et al. (2020). For example, Schnell and Currie (2018) find that physicians who trained at top-ranked medical schools prescribe substantially fewer opioids than those from lower-ranked schools, indicating that physician education may have a causal effect on prescribing behavior, independent of patient or physician selection. Despite the critical role that pharmacists play as the final gatekeepers of opioid distribution, surprisingly little is known about how their educational background and financial pressures influence their opioid dispensing practices. In this paper, we address this gap by focusing on pharmacists' roles in opioid dispensing, specifically examining how the rising costs of pharmacy education may impact their career choices and dispensing behaviors.

Our paper also contributes to a broader literature investigating the effects of education debt on human capital investment and career decisions. Using policy changes in financial aid in universities,

Rothstein and Rouse (2011) find that more student debt induces college graduates to pursue higher-salary jobs but reduces the probability of choosing low-paid public jobs. Using a similar context, Zhang (2013) shows that more college debt lowers graduate school attendance. A few other studies investigate how debt from college costs affects the career choice of medical students, who pay the highest tuition and fees among fields of study in the U.S. Rohlfing et al. (2014) surveyed medical students and report a strong association between debt level and the choice of their specialties.[6] Nicholson et al. (2015) surveyed dentists and find that dentists with higher initial debt are more likely to enter private practice, which offers higher salaries than public ones. Our study contributes to this literature by analyzing the career choice of pharmacists in response to education costs.

Lastly, the paper contributes to the literature on the labor market effects of non-wage job disamenities. According to the theory of equalizing differences, wages should compensate for non-wage job disamenities such as job insecurity, health risks, and performance pressure (Rosen, 1986). A strand of papers reports compensation differentials caused by non-wage workplace characteristics in various contexts (French and Dunlap, 1998; Villanueva, 2007; Wissmann, 2022; Nagler et al., 2023). However, some studies point out the difficulty in estimating the effects of job disamenities on compensating differentials because of endogenous matching and incomplete compensation information (Duncan and Holmlund, 1983; Eriksson and Kristensen, 2014; Lavetti, 2023). The findings of this study suggest the existence of pharmacists' willingness-to-pay (WTP) to avoid opioid dispensing and evidence for sorting into high-opioid pharmacies based on pharmacists' potential valuation of this disamenity. In particular, our paper takes advantage of a homogeneous workplace setting of pharmacies with similar firm sizes, tasks, skill requirements, and working conditions.

Our paper has important policy implications. First, the role of pharmacists in the opioid crisis has long been a black box, but our findings shed light on a key mechanism: pharmacists facing financial constraints due to high college costs are more likely to sort into pharmacies with higher opioid dispensing rates. This suggests that financial pressures may drive pharmacists to seek out positions where dispensing behavior is more aggressive, raising concerns about the sustainability

[6]Prior studies also show that an increase in college costs affects graduation timing and satisfaction among students. Garibaldi et al. (2012) find that increasing continuation tuition by 1,000 euros reduces the probability of late graduation by at least 6.1 percentage points. Velez et al. (2019) find that a 1,000-pound increase in tuition fees for UK full-time degree students in 1998 led to higher student debt and lower satisfaction, particularly among disabled students and those without family support. It also resulted in increased term-time employment for the latter group.

of such practices. If college costs were lower, this sorting mechanism would be weakened, potentially reducing the concentration of pharmacists with strong financial incentives in high-dispensing environments. Second, our findings highlight the need for policies that address the rising costs of pharmacy education, as these financial burdens may inadvertently contribute to the perpetuation of risky opioid dispensing practices. By alleviating the financial strain on pharmacists, policies could mitigate the influence of economic pressures on their professional behavior, promoting more responsible opioid dispensing practices across the industry.

2 Background

2.1 The Opioid Crisis and the Role of Pharmacists

The opioid crisis has emerged as one of the most pressing public health issues in the United States, with millions of individuals suffering from opioid misuse, addiction, and overdose. This crisis traces its roots back to the 1990s, when opioid pain relievers were increasingly prescribed, driven by aggressive marketing from pharmaceutical companies that downplayed the risks of addiction. As a result, the over-prescription of these medications led to the widespread availability of opioids in communities across the country. The consequences of this oversupply have been devastating, with a dramatic increase in opioid misuse, a surge in overdose deaths, and significant societal and economic impacts. The role of various stakeholders, including pharmaceutical distributors and healthcare providers, has been critically examined as a contributing factor to the escalation of the crisis.

Prescription opioids are dispensed through pharmacies, making proper procedures crucial to prevent potential harm (Bedene et al., 2022). A study analyzing testimony from a lawsuit against CVS in West Virginia revealed that the company neglected to implement an adequate suspicious order monitoring (SOM) system. Instead, it relied on employees to detect suspicious orders, lacking effective organizational controls (Gonick, 2022).

2.2 Factors Contributing to Improper Opioid Dispensing Practices

Using pharmaceutical industry documents released in litigation between 1997 and 2020, Chiu et al. (2023) conducted an observational, retrospective content analysis to assess the opioid dispensing practices of a retail community pharmacy chain, Walgreens.[7] The study identified four key factors contributing to improper opioid dispensing: (1) store-level procedures, (2) management pressure, (3) distribution center activities, and (4) pharmaceutical company sponsorship.[8] Among 21 documents reviewed in their study, management pressure was the most frequently discussed, in 10 documents.

The documents reviewed by Chiu et al. (2023) suggest that Walgreens management applied pressure on both store-level and corporate-level employees, which contribute to improper opioid dispensing practices. Internal reports, particularly those from the Walgreens employee hotline between 2010 and 2018, highlighted numerous conflicts between pharmacists and their supervisors regarding opioid prescriptions. Pharmacists often expressed concerns about being overruled by managers when they refused to fill certain prescriptions due to red flags. Managers, prioritizing customer satisfaction and productivity metrics, frequently pressured pharmacists to approve prescriptions, undermining their professional judgment. This tension created a work environment where pharmacists felt they had limited autonomy in decision-making, leading to instances of improper opioid dispensing.

Additionally, incident reports revealed that Walgreens' incentive structures, including performance metrics and bonus schemes, played a significant role in this issue. Managers were rewarded based on the number of opioid prescriptions filled, which encouraged them to pressure pharmacists to approve more opioid prescriptions, regardless of red flags or errors. At the corporate level, Walgreens management expressed concern about stores with lower opioid sales, even suggesting investigations into why these stores were not filling more prescriptions. This corporate focus on sales, coupled with bonus systems tied to prescription volumes, created a

[7] Investigating the practices of retail chain pharmacies has historically been challenging due to restricted access to internal decision-making processes (Bero, 2003). Recent studies on the opioid crisis have addressed this challenge by investigating internal documents that became available due to litigation (Yakubi et al., 2022; Caleb Alexander et al., 2022).

[8] Issues included unresolved red flags at the store level, pressure on pharmacists to fill more opioid prescriptions, distribution centers' failure to monitor high-volume orders, and pharmaceutical companies influencing pharmacists' continuing education.

culture where dispensing opioids was prioritized over patient safety. This dynamic ultimately resulted in agreements with the DEA, in which Walgreens agreed to remove controlled substances from compensation calculations, though concerns persisted about management's influence on dispensing practices.

2.3 Rising Costs of Pharmacy Education

The rising costs of pharmacy education have added another layer of complexity to the role of pharmacists in the opioid crisis. With the cost of obtaining a pharmacy degree steadily increasing, many pharmacists graduate with significant student debt. This financial burden can influence their career choices and professional behavior, potentially leading them to work in environments where opioid dispensing is more prevalent or where financial incentives are tied to prescription volume. The economic pressures associated with high educational costs may also impact their ability to make independent, patient-centered decisions, as the need to manage debt and secure stable, well-paying positions becomes a significant concern.

2.4 Potential Impacts of Rising Education Cost on Opioid Dispensing

The increasing cost of pharmacy education may influence opioid dispensing behavior through several mechanisms. First, the financial pressure to repay student loans may drive pharmacists to prioritize higher-paying positions, which could be associated with higher volumes of opioid prescriptions. Additionally, pharmacists working in environments where their income is linked to sales volume might be more inclined to dispense opioids more liberally. The financial burden of education may also affect how pharmacists view the risks associated with opioid dispensing, potentially leading to less cautious behavior. Furthermore, the decision-making process could differ between pharmacists who own their practices and those employed by larger chains, with the latter group potentially facing more pressure to meet corporate objectives that could conflict with best practices in opioid dispensing. Understanding these mechanisms is crucial for developing strategies to mitigate the impact of rising educational costs on opioid-related outcomes.

3 Data

To examine the relationship between opioid sales and college cost, we employ three primary data sources: (1) Lightcast Job Profile Data (formerly Burning Glass Technologies); (2) College Scorecard; (3) Automation of Reports and Consolidated Orders System (ARCOS). This section describes each of these data sources and the construction of our sample.

To collect job and education information on pharmacists in the U.S., we rely on the Lightcast Job Profile Database ("Lightcast" henceforth), which contains the longitudinal job history of more than 130 million workers in the U.S. Lightcast collects professional profiles from online career platforms such and LinkedIn and Indeed, where individuals share information about their employment, skills, and education. Lightcast utilizes machine-learning algorithms to unify duplicate profiles to create one unique master profile corresponding to one person. Based on the job profiles, the Lightcast database reports worker-level characteristics, such as gender, degree, field of study, experience year, and skill sets, and job-level characteristics, such as job title, employer name, occupation, industry, start and end dates, and location. The dataset covers the workers currently in the U.S. or working in the U.S. for their most recent jobs. We only use the profiles of workers who report "pharmacist" as their occupation (SOC code = 29-1051) and have education information. For each pharmacist, we identify the primary college degree if the field of study of the degree is a pharmacy-related major or if the college title includes "pharmacy school."[9]

We also employ the College Scorecard provided by the U.S. Department of Education to capture college costs and other college characteristics. The College Scorecard provides detailed information on the cost and value of 4,000 higher education institutions nationwide. Among other factors, we utilize tuition and fees, cost of attendance, admission rates, and percentages completed within 4, 6, and 8 years. Our primary measure of college costs is the expected tuition and fees until earning a diploma. Specifically, we use the completion rate within each year (4, 6, and 8 years) conditional on completing the program as the probability of earning a diploma in the year and multiply it by the corresponding year times the annual tuition and fees. We use tuition and fees as the primary measure of college costs because it is the most frequently reported among various cost measures. In our data, the average expected tuition and fees until earning a diploma is $82,042 in the 2010

[9]For pharmacists with missing field of study information, we define the last graduate degree as their primary college degree, considering that pharmacy schools offer graduate degrees in the U.S.

dollar value.

As a robustness check, we use the average attendance cost, including tuition and fees, books and supplies, and living expenses. The correlation between tuition and fees and the average cost of attendance is 0.96, conditional on both observed. Though these college-level cost measures are not specific to pharmacy schools, we use them as proxies for the costs of attending pharmacy schools under the assumption that college-level and department-level costs are highly correlated. Though tuition and fees at the college-department-year level is not available, we find that a dollar increase in the college-level annual tuition and fees is associated with a 0.452 dollar increase in the median student loan debt at the college-major level using the Field of Study Survey of College Scorecard (See Appendix Figure A1). In a similar logic, we control for college-level characteristics, such as college type, SAT scores, and the composition of students as proxies for the characteristics of pharmacy schools. We link College Scorecard and Lightcast via OPE ID for institutions.

Our primary opioid sales data are from the Automation of Reports and Consolidated Orders System (ARCOS), constructed by the U.S. Drug Enforcement Administration (DEA). The dataset includes substance transactions with practitioners and pharmacies from 2006 to 2019, which drug manufacturers and distributors should legally report to the DEA. We only use the transaction data with retail and chain pharmacies as buyers. We use the annual transactions of oxycodone in Morphine Milligram Equivalents (MME) as the primary measure of pharmacy-level opioid sales, considering that the literature focuses on oxycodone as the most abused prescription opioid. We also check the robustness of the results with hydrocodone sales, another widely abused prescription opioid. Both oxycodone and hydrocodone sales highly vary across pharmacies in the ARCOS database. While 25th-percentile pharmacies do not sell opioids at all, 25th-percentile pharmacies sell 2.07 million MME of oxycodone and 0.54 million MME of hydrocodone annually.[10] We link ARCOS to Lightcast via a job's employer name and location.

Table A1 presents the summary statistics of our sample across the tuition fee level (low, middle, and high based on college-level annual tuition and fees). Our sample includes 13,563 pharmacists (65,863 pharmacist-by-year observations), which cover about 10% of pharmacists working in health and personal care retailers.[11] As shown in Panel A, 40% of the sample pharmacists are women,

[10] Morphine Milligram Equivalents (MME) is the amount of milligrams of morphine an opioid dose is equal to when prescribed. For instance, 6.6mg of oxycodone is the equivalent dose to 10mg oral morphine.

[11] U.S. Bureau of Labor Statistics reports that the number of pharmacists working in the industry of health and

meaning that female pharmacists are under-represented in our sample.[12] Panel B reports the huge variation in the cost of attending college across three groups, while there is not much difference in academic level and student composition. Most importantly, in Panel C, we can observe the positive gradient of pharmacy-level oxycodone sales across college cost levels.

4 Empirical Strategy

We investigate whether higher college costs induce graduates from pharmacy schools to sell more opioids during their careers (or, more realistically, to get a job at pharmacies that sell more opioids). It is possible that graduates from colleges with high tuition and fees feel more of a financial burden after graduation and try to find a more lucrative job to expedite the repayment of student debt. At the same time, pharmacies selling more opioids, regardless of whether patients seem to misuse them, may offer higher salaries in general. To identify this relationship, we estimate regressions of the following form:

$$Y_{it} = \alpha + \beta \text{Rank}_i + X_i'\gamma + \theta_t + \varepsilon_{it} \tag{1}$$

where Y_{it} is the log of opioid sales to the pharmacy where pharmacist i works in year t. Rank_i is a vector of indicators for the level of expected college tuition and fees that we describe in Section 3. Specifically, we classify colleges into seven groups (septiles), ranging from low to high expected college tuition and fees.[13] Using this vector of indicators allows the effect of college costs to be nonlinear. It also enables us to check if particular groups drive the association between college costs and opioid sales. Alternatively, we also use the log of expected college tuition and fees rather than the vector of indicators to measure the elasticity of opioid sales to college costs.

θ_t is the year fixed effects to rule out mechanical association driven by increasing opioid use over time. X_i is a vector of individual-, college-, and pharmacy-level characteristics to control for

personal care retailers is 134,050 as of 2023. See here for more information.

[12]For instance, women accounted for 63% of pharmacy degree recipients in 2020 (Draugalis et al., 2022). This under-representation is partly because our sample includes pharmacists who graduated before the share of women in the pharmaceutical profession sharply increased and partly because males are more likely to use online job platforms. For instance, 56.2% of LinkedIn users are male, while 43.6% are female as of 2024 according to Expandi.

[13]College Scorecard misses college cost information for some years, even for the same college. We construct time-invariant cost measures for each college to minimize missing observations without losing generality. Specifically, we first deflate observed college costs to the level of 2010. Then, we regress the deflated college costs on college and year fixed effects. We classify colleges into subgroups based on the college fixed effects.

mechanisms other than college costs. In the baseline model, we add gender, graduation year fixed effects, the number of degrees (Bachelor's, Master's, and Doctoral), pharmacy type (chain or retail), and college type (public, profit private, and non-profit private). We cluster the observations at the college level, considering that the tuition and fees vary across colleges.

A positive association between college costs and opioid sales from equation (1) does not necessarily reflect a causal effect of college costs. There are two key threats:

1. Pharmacists who have a low repulsion against opioid misuse ex ante may have systematically chosen colleges with high tuition and fees for other reasons. Then, the association between college costs and opioid sales will reflect sorting across pharmacy schools at the time of college admission.

2. Pharmacists who attended colleges with high costs may be systematically more likely to join pharmacies that encounter patients with a greater need for opioids because of reasons other than high college costs. Then, the association between college costs and opioid sales could be at least partly driven by other sorting mechanisms.

While we do not have the data necessary to test whether pharmacists select into pharmacy schools based on the school characteristics correlated with their view on opioid sales, we can control for the potentially correlated school characteristics. We primarily control for the college traits that affect a college applicant's choice, such as SAT scores, admission rate, and the composition of enrolled students by race and gender.

We conduct two additional analyses to rule out mechanisms of sorting across pharmacies other than college costs. First, we check if the results of heterogeneity analyses are consistent with the context of the sorting mechanism through college costs. Specifically, we examine how the positive sales gradient differs across regions more or less exposed to opioid abuse. Though we cannot directly observe local opioid abuse, we can use local opioid prescriptions as the literature finds that local opioid prescriptions are strongly related to the misuse of opioids, including heroin, and opioid mortality rates (Alpert et al., 2018; Evans et al., 2019, 2022). So, we would expect the sales gradient to be steeper in more exposed areas because there is more variation in opioid sales across pharmacies in those areas. Plus, we investigate whether the positive sales gradient differs by other observable characteristics such as gender and business cycle.

Second, we additionally control for the factors that could potentially affect pharmacists' sorting across pharmacies with different levels of opioid sales. The factors include their skill sets (the number of certificates and the number of skills in each category) reported in the online profiles and the opioid exposures of local communities where her college and pharmacy are located. The former reflects a pharmacist's ability or knowledge about the seriousness of opioid misuse, and the latter controls for the geographic variation in opioid use that could mechanically generate the association between college costs and opioid sales. Alternatively, we control for county fixed effects to eliminate the mechanical association driven by other time-invariant local characteristics.

5 Results

5.1 Opioid Sale Gradient across College Costs

We begin by investigating the relationship between college costs that a pharmacist paid for her education and opioid dispensing at the pharmacy where she worked. Figure 2 shows the association between the level of tuition and fee (expected tuition and fee in panel (a) and annual tuition and fee in panel (b)) and the log of annual oxycodone sales at the pharmacy. We classify the observations into seven college cost bins (the lowest in Group 1 and the highest in Group 7) in the baseline model. However, we also conduct robustness checks with the number of subgroups in Section 5.2. The point estimate for a college cost bin indicates the log difference in oxycodone sales from that of the group with the lowest tuition group. We control for individual characteristics (gender, number of degrees, and graduation year), college characteristics (college type, SAT score, and the shares of students in racial and gender groups), pharmacy type, and year fixed effects.

Panel (a) of Figure 2 shows that a higher expected tuition cost in college is associated with more opioid sales in the pharmacist's career: pharmacists from the colleges with the highest tuition cost (Group 7) sell about 2.5 times more oxycodone during their career than pharmacists who attended the cheapest colleges (Group 1). Considering that the expected tuition cost for the lowest group is $45,650 and that for the highest group is $135,557 in the value of 2010, opioid sales increase twice in every $59,938 of college tuition and fees, all other things being equal. The graph also presents that oxycodone sales monotonically increase as the college tuition level increases, indicating that a

particular subgroup of pharmacists does not drive the positive association.

Panel (b) of Figure 2 presents a similar opioid sales gradient across annual tuition and fees, though the pattern of monotonic increase is less clear. The sharper gradient across expected tuition and fees indicates that the completion year affects the association between college costs and opioid sales. This result is reasonable, considering that college costs and the resultant student loan debt may not be as burdensome as they look from annual costs if students can graduate early from college on average. So, pharmacists would care about expected tuition and fees more if they sell more opioids to reduce the financial burden of college costs.

Turning to the results for pharmacists from the colleges without the information on tuition and fees, who account for about 8% of our sample, we see from Figure 2 that opioid sales of these pharmacists are not statistically different from those of pharmacists who graduated from the cheapest colleges. Though we cannot explicitly identify the level of tuition and fees for those colleges because of data limitations, but we can infer that the costs of these colleges should be low on average because about 64% of them are public schools specializing in health science and only 0.4% are private for-profit schools.

To capture the quantitative association between college costs and opioid sales, we report the estimated elasticity of oxycodone sales to tuition and fees in Table 2. Column (1) reports the positive elasticity of oxycodone sales to the expected tuition and fees, which is visualized in panel (a) of Figure 2. A 1% increase in the expected tuition and fees in college is associated with about a 1.45% increase in oxycodone sales during the pharmacist's career after controlling for the baseline covariates. The elasticity to annual tuition and fees is slightly higher (1.642), as shown in column (4).

As we discuss in Section 4, the striking positive association between college costs and opioid sales does not necessarily indicate the causal effect of the financial burden of college costs on opioid dispensing during a pharmacist's career. The other sorting mechanisms to pharmacy schools and to pharmacies could mechanically generate the association. To address these concerns, we meticulously control for additional factors, capturing other mechanisms in the next columns of Table 2.

First, in columns (2) and (4), we add a pharmacist's skill set (the number of certificates, general skills, software skills, cognitive skills, and social skills) reported in the profile data as proxies for

his/her ability. If there are skill premiums in the labor market of pharmacists and if higher education costs reflect better training for those skills, then their sorting based on skill levels could result in a positive association between college costs and opioid sales, considering the strong positive relationship between opioid sales and wage. Our results confirm that this is not the case. Controlling the logs of the skill measures does not mitigate the elasticities, and the point estimates slightly increase. The increase in the point estimates results from the strong negative associations between skills and oxycodone sales. Because a higher college cost results in better skills, which could raise cautiousness or reluctance about selling opioids, the partial effect of college costs could be higher.

It is also worth noting that cognitive and social skills have a strong negative association with oxycodone sales. A 1% increase in the number of a pharmacist's cognitive and social skills is correlated with a 0.348% and 0.968% decrease in oxycodone sales, respectively. In contrast, the number of certificates, general, and software skills show no strong relationship. These results imply that high-skilled pharmacists may sort into pharmacies in consideration of their opioid sales for two reasons. First, cognitive and social skills are more likely related to the awareness of the consequences of opioid abuse and the pang of conscience than the other skills. Second, if pharmacists were sorted solely based on wage level, the association between the skill measures and oxycodone sales should have been positive, considering the strong positive association between wage level and opioid sales.

Second, in columns (3) and (6), we additionally control for the local exposure to the opioid crisis around a pharmacist's college and workplace. The literature points out that there has been a substantial geographic variation in the number of opioid prescriptions and that local opioid prescriptions predict opioid abuse and mortality (Alpert et al., 2018; Evans et al., 2019; Powell and Pacula, 2021). If colleges with higher costs are concentrated in the areas that are more exposed to the opioid crisis or if graduates from those colleges are more likely to work in the more exposed areas, then our estimates may capture the mechanical relationship between college costs and opioid sales. To check this possibility, we control for normalized opioid prescriptions per capita in the counties where a pharmacist's college and workplace are located.

Columns (3) and (6) present that local opioid prescriptions have a strong correlation with pharmacy-level opioid dispensing. A one standard deviation increase in opioid prescriptions in the counties of college and workplace raises opioid sales from the pharmacy where the

pharmacists work by 62.2% and 221.5%, respectively. However, the positive association between college costs and opioid sales gets even stronger with the additional covariates, indicating that the geographic variation in the exposure to the opioid crisis does not drive the association between college costs and opioid sales.

The positive association between college costs and opioid sales has important policy implications. First, this result indicates that pharmacists at least indirectly affect opioid dispensing. Suppose a pharmacist is an owner of a pharmacy. In that case, our result implies that she may neglect an opioid abuser's medical record to raise opioid sales and expedite the repayment of student debt. If she is an employed pharmacist, she got a job at a high-paying pharmacy that actively sells opioids at the same time. In order not to lose the high salary there, she may inadvertently accommodate the pharmacy's sales policy, ignoring a signal of danger in the medical records of opioid abusers. Second, the cost of college attendance may exceed the level over which the graduates from pharmacy schools are tempted into selling abusable opioids during their careers to compensate for it. In any case, our result shows that pharmacists became a part of the US medical system that raises opioid abuses.

5.2 Robustness Checks

We now implement additional empirical exercises to check the robustness of our baseline results. Our argument on the mechanism of pharmacists' sorting mainly relies on the positive correlation between pharmacy-level Oxycodone sales and offered wages described in Figure 1. To check whether other factors drive this relationship, we report the regression of the log of offered wage on the log of oxycodone sales with additional covariates in Table 3. Column (1) presents that the positive association is statistically significant and economically meaningful after controlling pharmacy type and year fixed effects. Every time oxycodone sales double, offered wage increases by 1.6%. In the next columns, we report the parallel association after controlling for logs of skill requirements (schooling year, cognitive, social, and software skills) and county fixed effects, showing that the positive correlation between opioid sales and offered wages is robust to local, pharmacy, and job characteristics.

The association between college costs and opioid dispensing partly relies on our specifications

and variable choices. We now show the evidence that our results are robust to these research choices. First, one may be concerned that the clear monotonic relationship in Figure 2 could depend on the specific number of subgroups. Appendix Figure A2 indicates this is not the case, showing that the monotonic relationship holds with five and ten subgroups. Second, we use the expected or annual tuition and fees to measure college costs in our baseline model because it has the least missing observations among similar cost measures. In Appendix Table A2, we use a more inclusive college cost measure, the cost of attendance, which includes tuition and fees, books and supplies, and living expenses. The positive association is clear with this cost measure, though the point estimates are less statistically significant.

We also replace oxycodone with hydrocodone for the measure of opioid sales in Appendix Table A3. While oxycodone is reportedly the most abused prescription opioid in the U.S., hydrocodone, one of the most common pain medications, has also been widely abused and contributed to the opioid crisis (Cicero et al., 2013; Beheshti, 2023). The results indicate that the hydrocodone sales of pharmacists are also positively correlated with college costs, though this is less clear than the case with oxycodone. Lastly, in Appendix Table A4, we control for the college county and pharmacy county fixed effects rather than adding local opioid exposures to rule out any mechanical association driven by other geographic variations. Though these are not preferred specifications because the tuition and fees vary at the college level and there are not enough observations within each county, these results confirm that time-invariant unobservable heterogeneity across locations does not fully drive our baseline estimates.

5.3 Heterogeneity in Opioid Sale Gradient

In this section, we report the heterogeneity in the association between college costs and opioid sales. The purpose of this exercise is twofold. First, we check if the heterogeneous patterns are consistent with pharmacists' sorting by the financial burden of college costs. Second, we provide policy implications of the association based on the heterogeneity. Specifically, we investigate the association by geography, gender, business cycle, and school ranking.

Figure 3 reports the non-parametric relationship between the expected tuition and fee and opioid sales across the subgroups of pharmacists following Figure 2. First, considering the

substantial geographic variation in opioid prescriptions and abuse reported in the literature, it would be reasonable to see that pharmacists' sorting is more prominent in the regions more exposed to the opioid crisis. Panel (a) reports the association by counties with above-median opioid prescriptions per capita (high-exposed areas) and the other counties (low-exposed areas). The result confirms this hypothesis, showing that the positive association between college costs and opioid dispensing is more evident for pharmacists working in the more exposed areas. We can also observe the positive association in the low-exposed areas, but only a few top college cost groups drive the result.

Second, panel (b) reports the association by gender. Following the long literature on the gender difference in risk attitudes (Powell and Ansic, 1997; Eckel and Grossman, 2008; Croson and Gneezy, 2009), we would expect that female pharmacists may be more conservative in selling opioids because they could worry about the health and legal consequences of opioid abuse more than male pharmacists. Though there is no clear evidence on pharmacists, a meta-analysis on prescribing practices by gender concludes that female physicians are more likely to engage in conservative drug prescribing and to reduce the incidence of adverse drug events than male physicians (Mishra et al., 2020). Panel (b) confirms that this tendency is also the case for pharmacists, showing that the positive association between college costs and Oxycodone sales is much more prominent for male pharmacists than female ones. This result is consistent with the hypothesis that female pharmacists care about the risk of opioid abuse rather than quickly repaying student loans compared to male pharmacists.

Third, we also check the heterogeneity by business cycle, which could affect a pharmacist's incentive to sort by college costs. Specifically, we examine how the sales gradient differs across pharmacists who graduated during economic busts and those who graduated during economic booms. According to the literature on the outcomes of college graduates across business cycles, those who graduate in economic downturns have fewer job opportunities and are more financially constrained (Kahn, 2010; Oreopoulos et al., 2012; von Wachter, 2020). Thus, we would expect the gradient to be steeper for pharmacists who graduated during economic busts if the financial debt from college costs drives the sorting across pharmacies with different levels of opioid sales. Panel (c) shows that this may be the case, but it is hard to say that there is a big difference in the graduates' behavior across their graduation years.

To investigate whether any factor could mitigate this relationship, we investigate the heterogeneity by pharmacy school ranking. Schnell and Currie (2018) report evidence suggesting that quality education in high-ranked medical schools could lower opioid prescriptions of physicians. Similarly, pharmacists who completed their training in high-ranked pharmacy schools may be less likely to disperse opioids than those from low-ranked schools, ceteris paribus. We use three rankings of pharmacy schools for the comparison: a well-known school ranking published by US News and World Report (USNWR), and education and research rankings constructed by Lebovitz et al. (2022). While the USNWR ranking reflects a wide range of pharmacy schools' education, research, and finance factors, the rankings by Lebovitz et al. (2022) separate out the quality in education and research factors. We estimate the elasticity of opioid sales to college costs by high-ranked (1-30), middle-ranked (31-70), and low-ranked (70+) schools and report the results in Figure 4.[14]

Panel (a) of Figure 4 indicates that the association is weaker among the pharmacists who graduated from high-ranked schools in terms of the ranking by USNWR than those from lower-ranked schools. This heterogeneity does not necessarily result from the education quality or curriculum of high-ranked schools and may reflect unobservable characteristics of pharmacists who graduated from these schools. For instance, pharmacists from high-ranked schools have advantages in earning a high income even without consideration of selling more opioids. We see a similar, but less apparent, pattern by education ranking (panel (b)) and no heterogeneity across research ranking (panel (c)). So, our results imply that altering pharmacy education could help mitigate irresponsible opioid dispensing by pharmacists resulting from the financial burden of college costs.

5.4 Job Turnover of Pharmacists

So far, we have shown that pharmacists sort into pharmacies after graduating from pharmacy schools in a way that generates a robust positive association between college costs and opioid sales. We also found that the pharmacies selling more opioids offer higher salaries on average. So, one might be concerned that pharmacists suffering from a high student loan may sort into high-paying

[14]This classification is to maintain a sufficient number of observations for each group, and the results are robust to the other grouping.

pharmacies, and they may not recognize high opioid sales at the pharmacy. Then, we may capture the mechanical relationship between college costs and opioid dispensing driven by sorting based on financial burden from college costs and wage level. The association is still an interesting pattern, but we would like to know whether pharmacists are concerned about opioid dispensing during their careers to understand better the role of individual pharmacists in the opioid crisis.

To do this, we investigate whether a pharmacist's job turnover is associated with pharmacy-level Oxycodone sales in Table 4. Pharmacists may have no information on opioid sales from their workplace when they start a job. However, if they feel a sense of guilt later when selling opioids to people who are likely abusers, then they may be more likely to move to another job. Column (1) in panel A of Table 4 shows the regression of a hundred times the indicator of job turnover on the log of Oxycodone sales with the full covariates controlled. A hundred percent increase in Oxycodone sales is associated with a 4.9 percentage point increase in the probability of job turnover. This relationship is economically significant, considering that the average job turnover rate is 2.864%.

In the following columns, we check whether the movers transfer to low-opioid or high-opioid pharmacies. If the pharmacists move because of the disutility of opioid dispensing, they are likely to move to low-opioid pharmacies. The outcome in column (2) is a hundred times the indicator of a job transition to a pharmacy with Oxycodone sales lower than the median, and the outcome in column (3) is a hundred times the indicator of a job transition to a pharmacy with Oxycodone sales higher than or equal to the median. A hundred percent increase in Oxycodone sales is associated with a 3.4 percentage point increase in the probability of job turnover to low-opioid pharmacies. At the same time, there is no statistically significant relationship between Oxycodone sales and a job transition to high-opioid pharmacies. These results indicate that selling opioids could give disutility to pharmacists, inducing them to transfer to another workplace selling fewer opioids.

Panels B and C report the parallel associations for pharmacists who experienced college costs lower than the median and those who experienced college costs higher than and equal to the median, respectively. Panel B confirms that the turnover rate of pharmacists with low college costs is not statistically related to the level of Oxycodone sales, though the point estimates are economically significant. On the contrary, we can observe distinctly positive associations for pharmacists with high college costs. A hundred percent increase in opioid sales results in a 6.2 percentage point increase in the total turnover rate and a 4.5 percentage point increase in the rate of job turnover to a

low-opioid pharmacy. In other words, pharmacists who experienced high college costs show more job transitions to low-opioid pharmacies when the current opioid sales are higher. Thus, it is hard to argue that pharmacists with high college costs happen to get jobs in high-paying pharmacies, which also sell many opioids, and are not concerned about the high opioid sales.

Now, we additionally analyze how this tendency of pharmacists' job turnover affects the correlation between college costs and opioid sales during their careers. Considering the unwillingness of pharmacists with high college costs to sell opioids, the association between college costs and opioid sales should diminish by experience year. In other words, pharmacists having high debt from college costs may move to another pharmacy selling fewer opioids after clearing off the debt when the marginal disutility of debt gets lower than the marginal disutility of selling opioids. Otherwise, we would expect the positive association not to diminish by experience years. It can even increase because a high-opioid pharmacy is a high-paying one on average.

Panel (a) of Figure 5 confirms our hypothesis. The point estimates indicate the elasticity of opioid sales to college costs across experience years. We classify the observations into five subgroups based on experience years (1-2 years, 3-4 years, 5-6 years, 7-8 years, longer than 9 years) to balance the number of observations. The figure visualizes the decline of the elasticity by experience year, indicating that less experienced pharmacists mainly drive the positive association between college costs and opioid sales. If pharmacists who experienced high college costs target high-paying pharmacies regardless of opioid sales, there is no reason to observe this decline by experience years.

In panels (b) and (c), we check the parallel elasticity over experience years by local opioid exposure and gender, which showed clear distinctions in the opioid sale gradient in Section 5.3. Panel (b) presents a distinct pattern between pharmacists in the high-exposed and low-exposed areas. As shown in panel (a) of Figure 3, pharmacists in the regions that are highly exposed to the opioid crisis have high associations between college costs and opioid dispensing in general. More importantly, the association does not decline for pharmacists in the high-exposed areas over experience years. There are a couple of potential mechanisms to explain this result. First, in the high-exposed areas, opioid abuse is so prevalent that pharmacists may get used to it and may not feel disutility in dispensing opioids as their experiences grow. So, they may not have the incentive to move to a pharmacy selling fewer opioids. Still, pharmacists with high college debt tend to

work in high-opioid pharmacies after graduation because of the high wages there. Second, even if pharmacists would like to move to a low-opioid pharmacy after relieving debt, finding such a workplace in high-exposed regions may not be easy.

Panel (c) indicates that the association between college costs and opioid dispensing sharply declines by experience years for male pharmacists. At the same time, it does not change over the years of experience for female pharmacists because they have a weak association even in the early stages of their careers. Consistent with panel (b) of Figure 3, this result confirms that male pharmacists drive the association. However, on top of that, we can also observe that male pharmacists move to low-opioid pharmacies as they get experienced or as they repay their student loans to some extent. This pattern also cannot be explained by the sorting based on wage level. Thus, this subsection confirms that pharmacy-level opioid sales are systematically related to the job transition of pharmacists and that their career choices mitigate the association between college costs and opioid sales over experience years.

6 Conclusion

CONCLUSION

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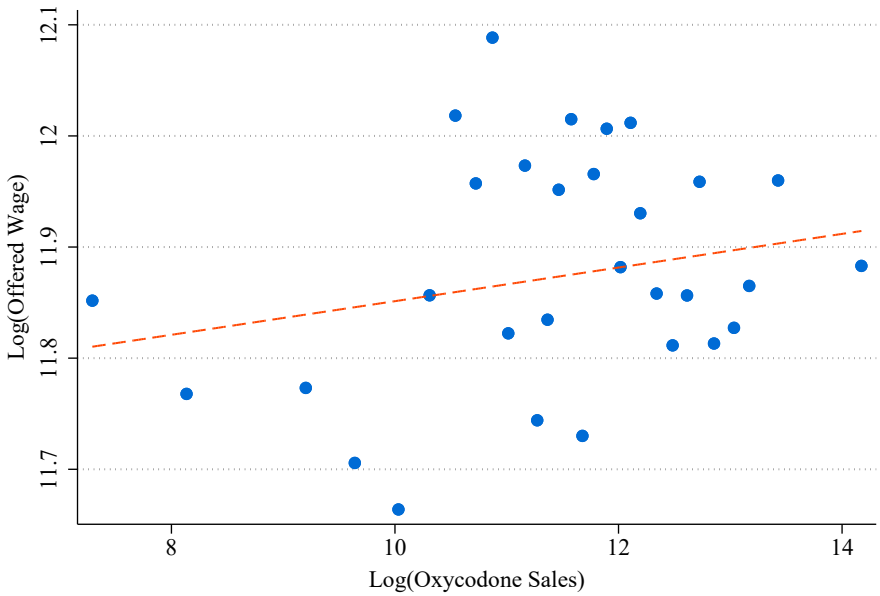
7 Figures and Tables

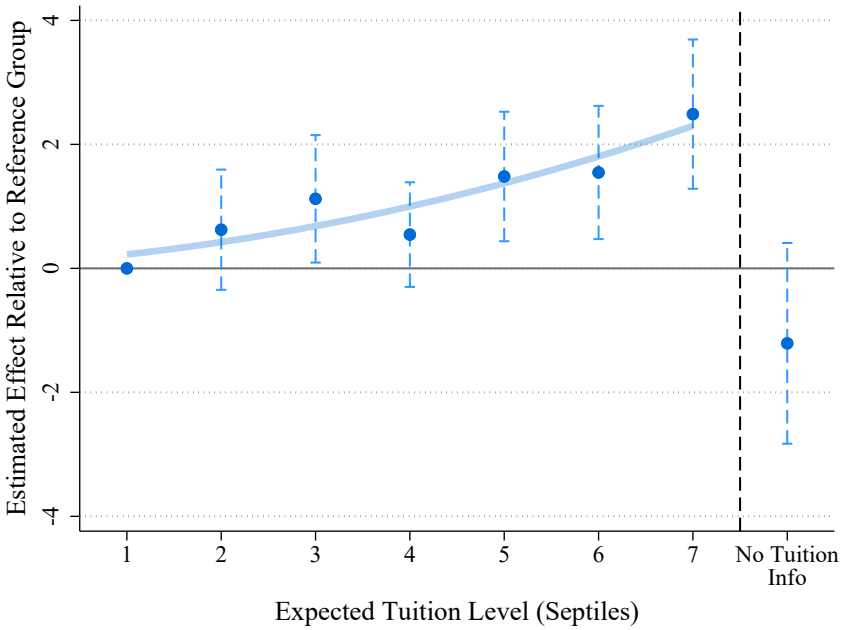
Figure 1: Association between Oxycodone Sales and Offered Wages



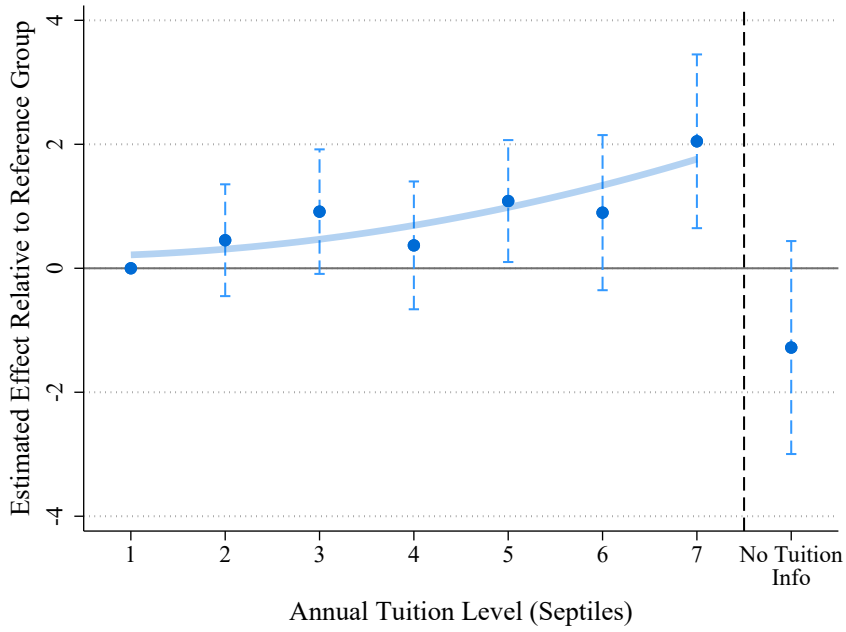
Notes: This figure presents the correlation between pharmacy-level oxycodone sales and offered wages. The x-axis represents the log of oxycodone sales, while the y-axis represents the log of offered wages. The red dashed line indicates the linear regression line fitted to the binned scatter plot data.

Figure 2: Oxycodone Sales by Expected Tuition Level

(a) By Expected Tuition and Fee



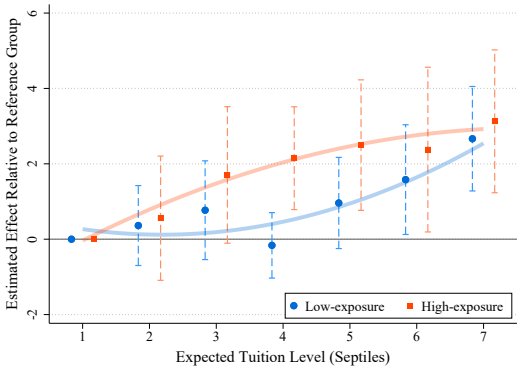
(b) By Annual Tuition and Fee



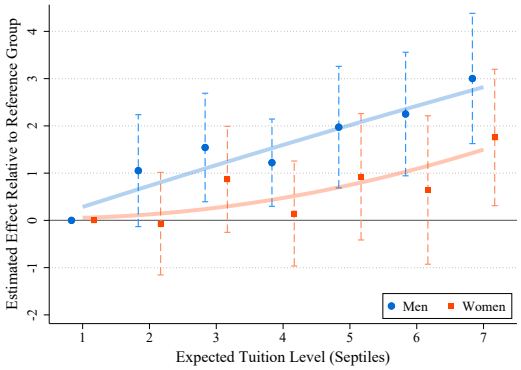
Notes: This figure shows the association between the log of pharmacy-level oxycodone sales and pharmacist-level tuition levels. In Panel (a), the estimated effect relative to the reference group is plotted across septiles of expected tuition and fees. Panel (b) displays a similar pattern, using annual tuition levels. The controls include individual characteristics (gender, number of degrees, and graduation year), college characteristics (college type, SAT score, and the shares of students in racial and gender groups), pharmacy type, and year fixed effects. The observations are clustered at the college level. A consistent increasing trend is evident in both panels, where higher tuition levels correspond to larger estimated effects. The patterns observed are stable, regardless of the specific number of subgroups chosen, demonstrating the robustness of the results.

Figure 3: Heterogeneity of Association between Tuition Fee and Oxycodone Sales

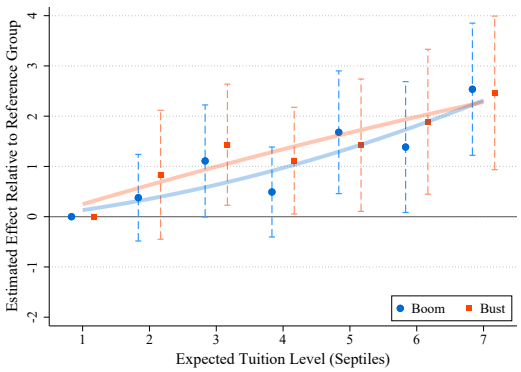
(a) By Opioid Exposure



(b) By Gender



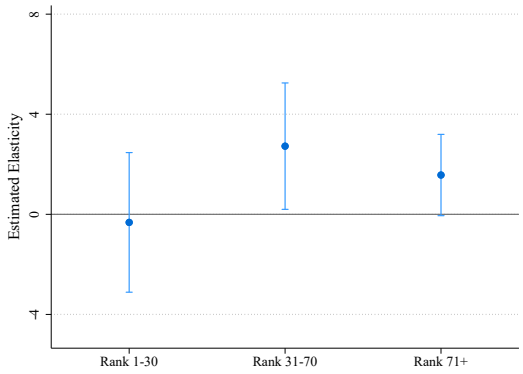
(c) By Business Cycle



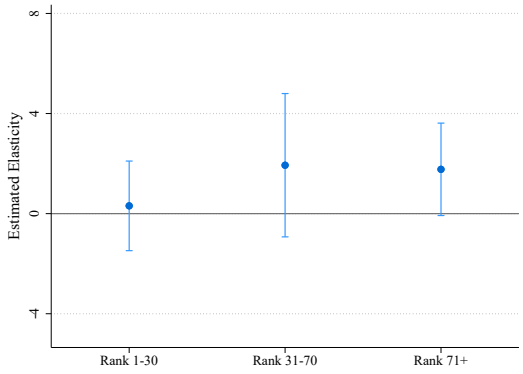
Notes: This figure shows the association between pharmacy-level oxycodone sales and pharmacist-level tuition levels across subgroups of pharmacists. The estimated effect relative to the reference group is plotted across septiles of expected tuition and fees. Panel (a) reports the estimates for pharmacists in counties with below-median opioid prescriptions (blue dots) and pharmacists in counties with above-median opioid prescriptions (orange dots). Panel (b) reports the estimates for male pharmacists (blue dots) and female pharmacists (orange dots). Panel (c) reports the estimates for pharmacists who graduated in years with below-median employment rate (blue dots) and pharmacists who graduated in years with above-median employment rate (orange dots). The controls include individual characteristics (gender, number of degrees, and graduation year), college characteristics (college type, SAT score, and the shares of students in racial and gender groups), pharmacy type, and year fixed effects. The observations are clustered at the college level.

Figure 4: Association between Tuition Fee and Oxycodone Sales by Pharmacy School Rank

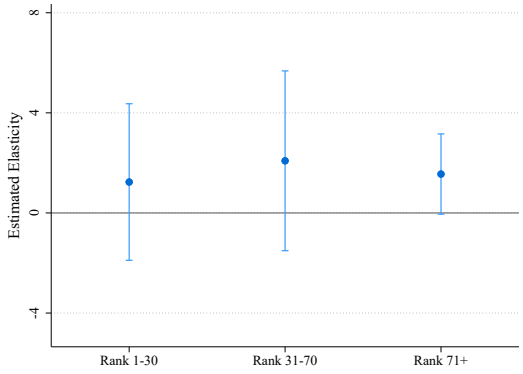
(a) By USNWR



(b) By Education Rank



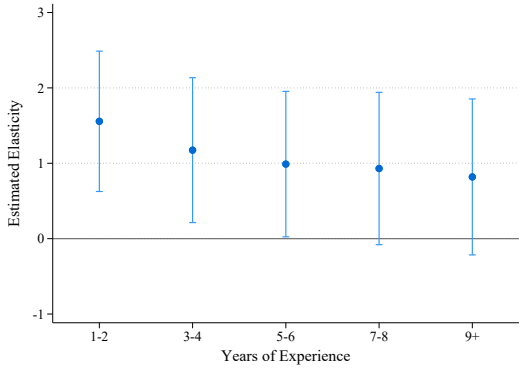
(c) By Research Rank



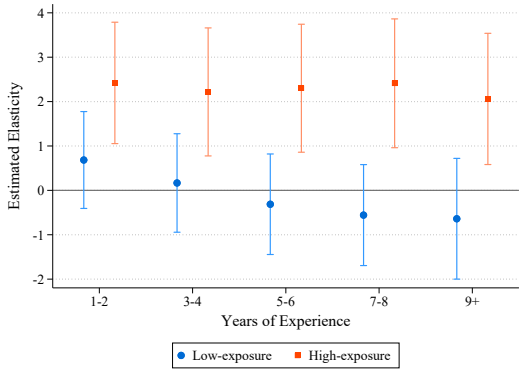
Notes: This figure shows the elasticity of pharmacy-level oxycodone sales to the expected tuition and fees by the ranking of pharmacy schools. The panels report the elasticity by the US News and World Report (USNWR) ranking (panel a), by education (panel b) and research (panel c) rankings constructed by Lebovitz et al. (2022). The controls include individual characteristics (gender, number of degrees, and graduation year), college characteristics (college type, SAT score, and the shares of students in racial and gender groups), pharmacy type, and year fixed effects. The observations are clustered at the college level.

Figure 5: Association between Oxycodone Sales and Tuition Fee by Experience Year

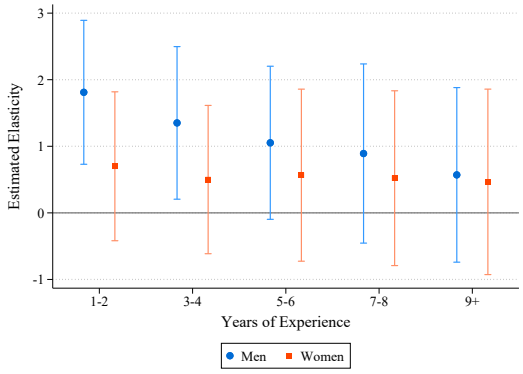
(a) Overall



(b) Heterogeneity by Opioid Exposure



(c) Heterogeneity by Gender



Notes: This figure shows the elasticity of pharmacy-level oxycodone sales to the expected tuition and fees by experience years. Panel (a) reports the elasticities for all pharmacists. Panel (b) reports the elasticities for pharmacists in counties with below-median opioid prescriptions (blue dots) and pharmacists in counties with above-median opioid prescriptions (orange dots). Panel (c) reports the elasticities for male pharmacists (blue dots) and female pharmacists (orange dots). The controls include individual characteristics (gender, number of degrees, and graduation year), college characteristics (college type, SAT score, and the shares of students in racial and gender groups), pharmacy type, and year fixed effects. The observations are clustered at the college level.

Table 1: Summary Statistics

	Tuition Fee Level			
	Low	Mid	High	No Info
Number of pharmacists	4047	4182	4151	1183
Pharmacist-year observations	20289	21320	18849	5405
A. Pharmacist Characteristics				
Female	0.42 (0.49)	0.38 (0.49)	0.39 (0.49)	0.39 (0.49)
Year of Graduation	2001.73 (12.15)	1999.98 (12.91)	2002.93 (11.74)	2003.67 (11.46)
Number of Certificates	0.57 (1.12)	0.60 (1.09)	0.66 (1.19)	0.65 (1.18)
General Skills	2.07 (3.24)	2.12 (3.24)	2.29 (3.31)	2.25 (3.40)
Cognitive Skills	1.14 (2.10)	1.29 (2.29)	1.27 (2.18)	1.49 (2.78)
Social Skills	5.75 (6.38)	5.98 (6.41)	6.30 (6.63)	6.56 (6.68)
Software Skills	0.54 (1.53)	0.56 (1.39)	0.66 (1.49)	0.62 (1.50)
B. College Characteristics				
Public College	0.96 (0.20)	0.89 (0.31)	0.02 (0.13)	0.65 (0.48)
Private Non-profit College	0.02 (0.12)	0.11 (0.31)	0.98 (0.13)	0.35 (0.48)
Annual Tuition and Fees	12033.6 (2200.7)	16762.9 (1857.5)	28257.8 (3931.0)	1879.8 (.)
Exp. Tuition and Fees	54279.9 (9363.5)	73690.3 (6718.0)	121372.9 (17251.9)	. (.)
Annual Cost of Attendance	19901.3 (2942.5)	23999.2 (4517.1)	43099.7 (5331.7)	. (.)
SAT Score	1117.86 (89.74)	1194.22 (85.89)	1165.39 (85.98)	. (.)
Admission Rate	0.74 (0.15)	0.63 (0.14)	0.69 (0.12)	0.43 (0.18)
Completion within 4 Years	0.40 (0.13)	0.52 (0.10)	0.55 (0.11)	0.77 (0.13)
Share of White Students	0.57 (0.19)	0.53 (0.17)	0.53 (0.15)	0.44 (0.26)
Share of Black Students	0.12 (0.17)	0.10 (0.15)	0.08 (0.07)	0.07 (0.07)
Share of Hispanic Students	0.08 (0.09)	0.08 (0.06)	0.07 (0.07)	0.09 (0.14)
Share of Female Students	0.54 (0.07)	0.53 (0.08)	0.58 (0.08)	0.76 (0.14)
C. Pharmacy Characteristics				
Retail Pharmacy	0.71 (0.45)	0.73 (0.44)	0.72 (0.45)	0.80 (0.40)
Oxycodone Sales (Million MME)	1.31 (2.62)	1.44 (2.59)	1.53 (3.06)	1.35 (3.03)
Hydrocodone Sales (Million MME)	0.52 (0.96)	0.52 (0.91)	0.40 (0.80)	0.46 (0.87)

Notes: This table presents the summary statistics of individual-, college-, and pharmacy-level characteristics of the pharmacists in our sample. Panel A presents the statistics of individual characteristics collected from the Lightast Job Profile Database. Panel B presents the statistics of college characteristics reported in the College Scorecard. Panel C presents the statistics of pharmacy characteristics from the Automation of Reports and Consolidated Orders System (ARCOS).

Table 2: Association between Oxycodone Sales and Tuition Fee

	(1)	(2)	(3)	(4)	(5)	(6)
	Log(Oxycodone)					
Log(Exp. Tuition Fee)	1.451**	1.525***	1.984***			
	(0.573)	(0.569)	(0.604)			
Log(Annual Tuition Fee)				1.642***	1.707***	2.177***
				(0.586)	(0.581)	(0.602)
Log(Certificates)		-0.004	-0.108		-0.006	-0.110
		(0.096)	(0.095)		(0.096)	(0.095)
Log(General Skills)		-0.011	0.068		-0.011	0.066
		(0.082)	(0.085)		(0.082)	(0.085)
Log(Cognitive Skills)		-0.348***	-0.088		-0.348***	-0.088
		(0.109)	(0.089)		(0.108)	(0.089)
Log(Social Skills)		-0.968***	-0.173***		-0.963***	-0.171***
		(0.151)	(0.060)		(0.151)	(0.060)
Log(Software Skills)		-0.233*	-0.161		-0.236*	-0.165
		(0.120)	(0.116)		(0.121)	(0.117)
Opioid Rx (College)			0.622*			0.643*
			(0.353)			(0.373)
Opioid Rx (Pharmacy)			2.215***			2.211***
			(0.342)			(0.344)
Observations	58,839	58,839	58,094	58,839	58,839	58,094
Baseline Controls	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Skill Controls	N	Y	Y	N	Y	Y
Local Opioid Controls	N	N	Y	N	N	Y

Notes: This table reports the elasticity of pharmacy-level oxycodone sales to the expected tuition and fees in columns (1) to (3) and to the annual tuition and fees in columns (4) to (6). The baseline controls in columns (1) and (4) include individual characteristics (gender, number of degrees, and graduation year), college characteristics (college type, SAT score, and the shares of students in racial and gender groups), and pharmacy type. Columns (2) and (5) additionally control for a pharmacist's skill set (the logs of certificates, general skills, cognitive skills, social skills, and software skills). Columns (3) and (6) add the total opioid prescriptions in the counties of college and workplace as covariates. The observations are clustered at the college level.

Table 3: Association between Oxycodone Sales and Offered Wages

	(1)	(2)	(3)	(4)
	Log(Offered Wage)			
Log(Oxycodone)	0.016***	0.015***	0.015***	0.010***
	(0.002)	(0.002)	(0.002)	(0.003)
Log(Schooling Year)		0.264***	0.269***	0.188***
		(0.016)	(0.016)	(0.017)
Log(Cognitive Skills)			0.036**	0.097***
			(0.016)	(0.018)
Log(Social Skills)			-0.025	-0.030
			(0.015)	(0.019)
Log(Software Skills)			-0.026	-0.181***
			(0.027)	(0.034)
Observations	4,900	4,505	4,407	4,232
Pharmacy Type	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
County FE	N	N	N	Y

Notes: This table reports the elasticity of pharmacy-level average offered wages to oxycodone sales. The offered wages and skill requirements (schooling year, cognitive, social, and software skills) are collected for 2007 and 2010-2019 from the Lightcast Online Job Posting Database, which covers the universe of online job advertisements in the U.S. The observations are clustered at the pharmacy level. The observations are weighted by the number of job postings.

Table 4: Association between Job Turnover and Oxycodone Sales

	(1) Turnover	(2) Turnover to Low Opioid	(3) Turnover to High Opioid
Panel A: Overall Sample			
Log(Oxycodone)	0.049***	0.034***	0.015
	(0.015)	(0.012)	(0.009)
Observations	58,094	58,094	58,094
Mean	2.864	1.473	1.390
Panel B: Pharmacists with Low College Costs			
Log(Oxycodone)	0.042	0.029	0.013
	(0.026)	(0.021)	(0.016)
Observations	28,776	28,776	28,776
Mean	2.864	1.473	1.390
Panel C: Pharmacists with High College Costs			
Log(Oxycodone)	0.062***	0.045***	0.017*
	(0.015)	(0.014)	(0.010)
Observations	29,318	29,318	29,318
Mean	2.864	1.473	1.390
Baseline Controls	Y	Y	Y
Year FE	Y	Y	Y
Skill Controls	Y	Y	Y
Local Opioid Controls	Y	Y	Y

Notes: This table reports the association between the log of pharmacy-level oxycodone sales and pharmacist-level job turnover. The outcome variables are the dummies for overall turnover (column 1), turnover to a pharmacy with below-median oxycodone sales (column 2), and turnover to a pharmacy with above-median oxycodone sales (column 3). The samples are all pharmacists (panel A), pharmacists who paid below-median expected tuition and fees (panel B), and pharmacists who paid above-median expected tuition and fees (panel C). The baseline controls include individual characteristics (gender, number of degrees, and graduation year), college characteristics (college type, SAT score, and the shares of students in racial and gender groups), and pharmacy type.

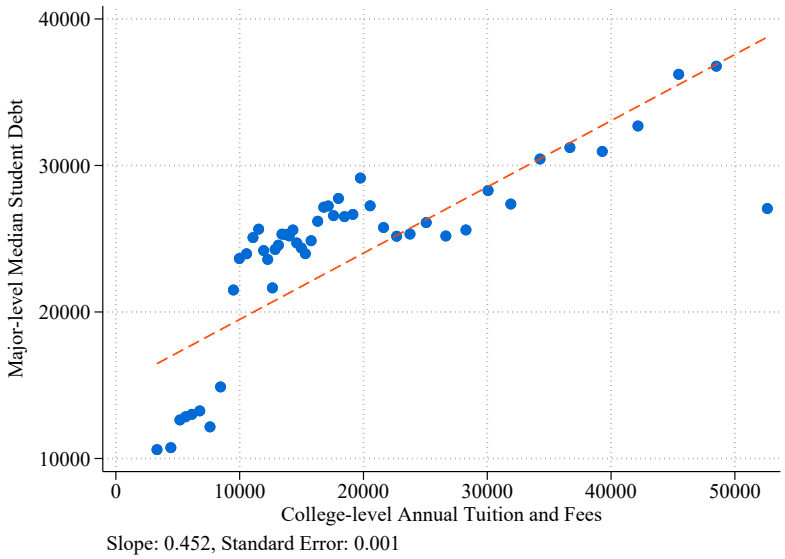
For Online Publication

"Pharmacy School Cost and Opioid Dispensing:
A Hidden Connection?"

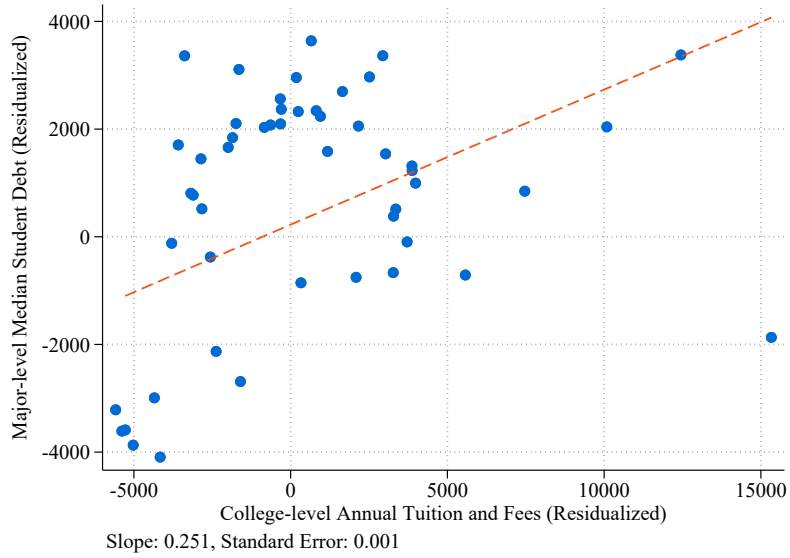
Kim, Kim, and Park (2024)

Figure A1: Association between College-level Tuition and Fees and Major-level Student Debt

(a) Raw Dollar Values



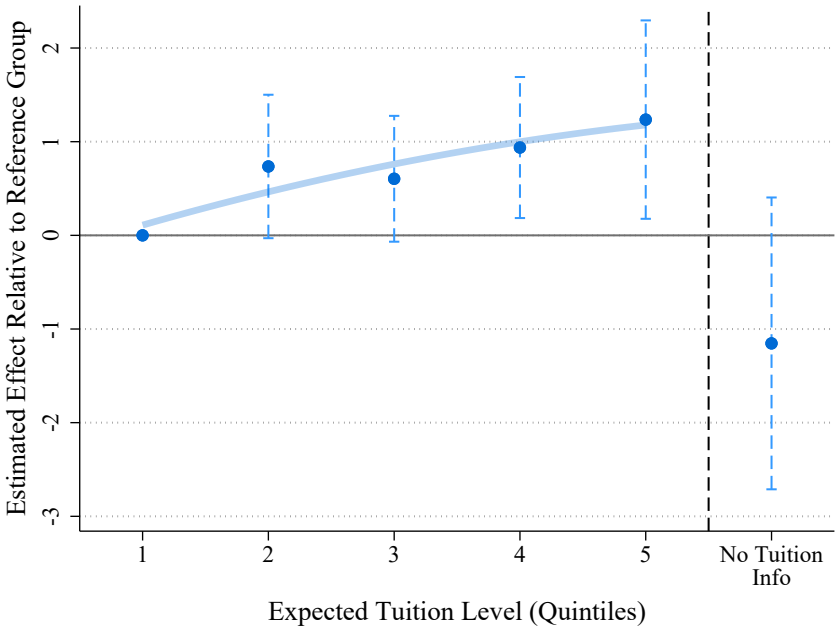
(b) Residualized Dollar Values



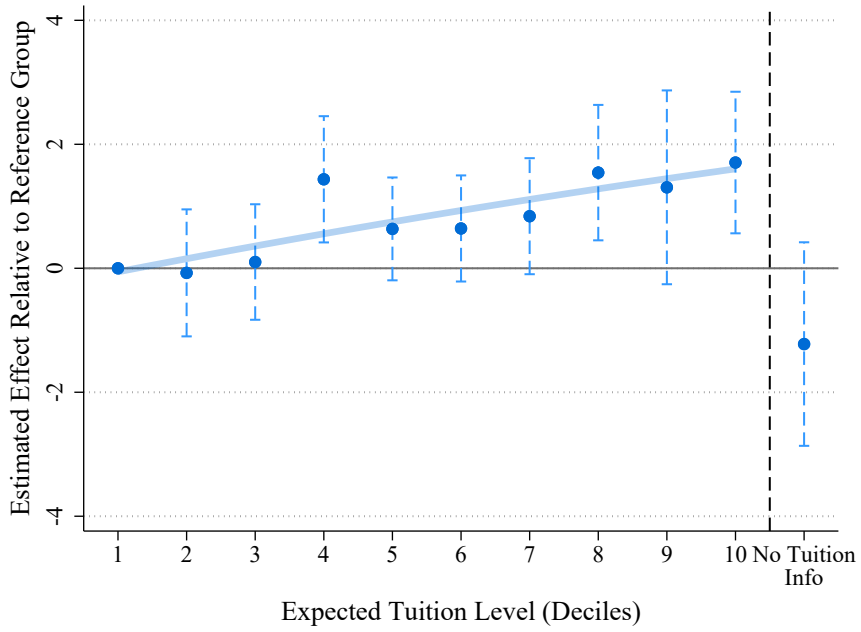
Notes: This figure shows the association between college-level average tuition and fees and major-level median student debts. The major-level student debts are federal borrowers' median cumulative federal loan debt from the College Scorecard Field of Study Survey for 2014-2018. The federal loan debt includes only loan disbursement amounts and does not capture any accrued interest. Panel (a) reports the association in raw dollar values and Panel (b) reports the association after controlling for college type, campus type (main campus or not), year fixed effects, and field of study fixed effects (CIP code). The observations are at college-major-year level and are clustered at the college level to estimate the slopes.

Figure A2: Oxycodone Sales by Other Tuition Grouping

(a) By Deciles



(b) By Quintiles



Notes: This figure shows the association between pharmacy-level oxycodone sales and pharmacist-level tuition levels across subgroups of pharmacists. Panels report the estimates by deciles (panel a) and quintiles (panel b). The controls include individual characteristics (gender, number of degrees, and graduation year), college characteristics (college type, SAT score, and the shares of students in racial and gender groups), pharmacy type, and year fixed effects. The observations are clustered at the college level.

Table A1: Summary Statistics

	Mean	SD	25th percentile	75th percentile	Pharmacist-year Observations
A. Pharmacist Characteristics					
Female	0.40	0.49	0.00	1.00	65863
Year of Graduation	2001.67	12.30	1994.00	2011.00	65863
Number of Certificates	0.61	1.14	0.00	1.00	65863
Number of General Skills	2.16	3.28	0.00	3.00	65863
Number of Cognitive Skills	1.25	2.25	0.00	2.00	65863
Number of Social Skills	6.05	6.50	1.00	9.00	65863
Number of Software Skills	0.59	1.47	0.00	0.00	65863
B. College Characteristics					
Public College	0.64	0.48	0.00	1.00	65863
Private Non-profit College	0.35	0.48	0.00	1.00	65863
Annual Tuition and Fees	18759	7237	13340	23912	60459
Exp. Tuition and Fees	82042	30061	59686	102671	60458
Annual Cost of Attendance	28620	10841	20503	39324	60169
SAT Score	1161	93	1089	1218	58873
Admission Rate	0.68	0.14	0.61	0.78	59619
Completion within 4 Years	0.51	0.15	0.42	0.60	65077
Share of White Students	0.54	0.18	0.42	0.67	64826
Share of Black Students	0.10	0.14	0.04	0.11	64826
Share of Hispanic Students	0.08	0.08	0.04	0.08	64826
Share of Female Students	0.57	0.10	0.51	0.60	65226
C. Pharmacy Characteristics					
Retail Pharmacy	0.73	0.44	0.00	1.00	65863
Oxycodone Sales (Million MME)	1.42	2.78	0.00	2.07	65863
Hydrocodone Sales (Million MME)	0.48	0.89	0.00	0.54	65863

Notes: This table presents the summary statistics of individual-, college-, and pharmacy-level characteristics of the pharmacists in our sample. Panel A presents the statistics of individual characteristics collected from the Lightast Job Profile Database. Panel B presents the statistics of college characteristics reported in the College Scorecard. Panel C presents the statistics of pharmacy characteristics from the Automation of Reports and Consolidated Orders System (ARCOS).

Table A2: Association between Oxycodone Sales and College Costs

	(1)	(2)	(3)	(4)	(5)	(6)
			Log(Oxycodone)			
Log(Exp. College Cost)	1.266	1.326*	1.779**			
	(0.818)	(0.797)	(0.804)			
Log(Ann. College Cost)				1.617*	1.664**	2.146***
				(0.858)	(0.837)	(0.821)
Observations	58,839	58,839	58,094	58,839	58,839	58,094
Baseline Controls	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Skill Controls	N	Y	Y	N	Y	Y
Local Opioid Controls	N	N	Y	N	N	Y

Notes: This table reports the elasticity of pharmacy-level oxycodone sales to the expected cost of attendance in columns (1) to (3) and to the annual cost of attendance in columns (4) to (6). The baseline controls in columns (1) and (4) include individual characteristics (gender, number of degrees, and graduation year), college characteristics (college type, SAT score, and the shares of students in racial and gender groups), and pharmacy type. Columns (2) and (5) additional control for a pharmacist's skill set (the logs of certificates, general skills, cognitive skills, social skills, and software skills). Columns (3) and (6) add the total opioid prescriptions in the counties of college and workplace as covariates. The observations are clustered at the college level.

Table A3: Association between Hydrocodone Sales and Tuition Fee

	(1)	(2)	(3)	(4)	(5)	(6)
			Log(Hydrocodone)			
Log(Exp. Tuition Fee)	0.654	0.730	1.226**			
	(0.563)	(0.554)	(0.537)			
Log(Annual Tuition Fee)				0.771	0.840	1.350**
				(0.578)	(0.570)	(0.548)
Observations	58,839	58,839	58,094	58,839	58,839	58,094
Baseline Controls	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Skill Controls	N	Y	Y	N	Y	Y
Local Opioid Controls	N	N	Y	N	N	Y

Notes: This table reports the elasticity of pharmacy-level hydrocodone sales to the expected tuition and fees in columns (1) to (3) and to the annual tuition and fees in columns (4) to (6). The baseline controls in columns (1) and (4) include individual characteristics (gender, number of degrees, and graduation year), college characteristics (college type, SAT score, and the shares of students in racial and gender groups), and pharmacy type. Columns (2) and (5) additional control for a pharmacist's skill set (the logs of certificates, general skills, cognitive skills, social skills, and software skills). Columns (3) and (6) add the total opioid prescriptions in the counties of college and workplace as covariates. The observations are clustered at the college level.

Table A4: Association between Oxycodone Sales and Tuition Fee after Controlling Location Fixed Effects

	(1)	(2)	(3)	(4)	(5)	(6)
	Log(Oxycodone)					
Log(Exp. Tuition Fee)	1.632***	1.109	0.981**			
	(0.472)	(0.676)	(0.422)			
Log(Annual Tuition Fee)				1.719***	1.952*	1.339**
				(0.507)	(1.030)	(0.583)
Observations	59,649	59,631	59,564	59,655	59,637	59,570
Full Controls	Y	Y	Y	Y	Y	Y
College Location FE	N	Y	Y	N	Y	Y
Pharmacy Location FE	N	N	Y	N	N	Y

Notes: This table reports the elasticity of pharmacy-level oxycodone sales to the expected tuition and fees in columns (1) to (3) and to the annual tuition and fees in columns (4) to (6). The baseline controls include individual characteristics (gender, number of degrees, and graduation year), college characteristics (college type, SAT score, and the shares of students in racial and gender groups), and pharmacy type. Columns (2) and (5) additionally control for the fixed effects of the county where the college of a pharmacist is located. Columns (3) and (6) add the fixed effects of the county where the workplace of a pharmacist is located as a covariate. The observations are clustered at the college level.