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Health Care Reform and Firm Dynamics: Evidence from Medicare Part D and the Retail Pharmacy Industry

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Abstract

Retail pharmacies fill over 4 billion prescriptions each year and are the most frequent service delivery touchpoint in the U.S. health care system. Despite this important role, relatively little is known about the economic factors driving pharmacy access. We provide new evidence on how Medicare Part D shaped the retail pharmacy industry using 2000-2009 National Establishment Time-Series data and a difference-in-differences identification strategy leveraging variation in the pre-period share of the customer base likely comprised of Medicare beneficiaries. While Medicare Part D increased prescription utilization, it also lowered drug prices and increased administrative costs, resulting in an ambiguous net effect on retail pharmacies. We find that Medicare Part D was associated with a 5 percent reduction in the number of pharmacies. This change was due to a reduction in the number of pharmacy openings; we do not detect a change in pharmacy closures. Next, we show that pharmacies located in the most competitive areas benefited from reduced market entry. Finally, we find suggestive evidence that the mortality reduction attributable to Medicare Part D was smaller in counties that experienced a reduction in pharmacy access.

JEL Codes: I18; M20
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1. Introduction

Retail pharmacies are an integral part of the U.S. health care system. Pharmacies fill over 4 billion prescriptions each year (Kaiser Family Foundation 2019) and are the most frequent service delivery touchpoint in the health care system (Trygstad 2020). Patients with commercial insurance (Valliant et al. 2022) and Medicare (Berenbrok et al. 2020) visit a pharmacy almost twice as often as they visit a physician, and pharmacists are among the most trusted members of the health care community (McHugh et al. 2022). Recognizing the potential for pharmacists to relieve a shortage of primary care physicians (Manolakis and Skelton 2010), states have passed scope-of-practice expansions allowing pharmacists to prescribe and administer a growing list of medicines, including vaccines (Trogdon et al. 2016; McConeghy and Wing 2016; Poudel et al. 2019), rescue inhalers and insulin pens (Shakya et al. 2024), and medications to prevent opioid overdoses (Abouk et al. 2019; Smart et al. 2024). Indeed, pharmacies' expanded role in delivering health care was highlighted during the COVID-19 pandemic (Viscari et al. 2021), and pharmacists played a central role in the nationwide COVID-19 vaccination campaign (Brownstein et al. 2022).

Despite pharmacies' ever-growing role in health care delivery, the industry has experienced significant challenges (Guadamuz et al. 2019). Between 2003 and 2018, one in six independent (i.e., non-chain) rural pharmacies closed (Salako et al. 2018). While the closure rate has generally been lower for chain pharmacies, many of these establishments have also struggled. From 2018 to 2020, CVS Health closed 244 stores and announced plans to close an additional 900 stores by the end of 2024 (CNN 2024). Likewise, Rite Aid announced the closure of approximately 25 percent of their stores when it filed for bankruptcy in 2023 (Bloomberg 2024); less than two years later, the company is considering a second bankruptcy (Wall Street

Journal 2025). Pharmacy closures have disproportionately occurred in areas serving low-income patients and members of racial and ethnic minority communities (Guadamuz et al. 2024), potentially exacerbating existing health disparities (Essien et al. 2021). While these location decisions have important implications for health care access, relatively little is known about the determinants of retail pharmacy formation, performance, and dissolution.

In this paper, we provide novel evidence on the role of government policy in shaping the retail pharmacy industry by studying the passage and implementation of Medicare Part D. Established by the Medicare Prescription Drug, Improvement, and Modernization Act of 2003, Medicare Part D provides prescription drug coverage to over 53 million enrollees (Sayed et al. 2023). At the time of its passage, it was the largest public health insurance expansion in the United States in over forty years (Oliver et al. 2004). Medicare Part D spending is projected to be $137 billion in 2025, representing 15 percent of all Medicare spending (Kaiser Family Foundation 2024).

The relationship between Medicare Part D and retail pharmacy performance is theoretically ambiguous. While the introduction of Part D was associated with increased prescription drug utilization (Lichtenberg and Sun 2007; Ketcham and Simon 2008; Yin et al. 2008; Kaestner and Khan 2012), it also substantially reduced drug prices (Duggan and Scott Morton 2010; Duggan and Scott Morton 2011; Lakdawalla and Yin 2015) and increased administrative costs (Radford et al. 2007; Bono and Crawford 2010; Zhang et al. 2010). Prior to Part D, retail pharmacies were able to earn high margins on underinsured and insured cash customers (Berndt and Newhouse 2010), and gross margins on prescriptions covered by Medicare Part D were lower than those covered by Medicaid, commercial insurance, or cash customers (Spooner 2008).[1] Indeed, there is evidence that prescription drug

[1] For example, CVS Caremark noted in its 2007 10-K that, "The Medicare Drug Benefit became effective on January 1, 2006. Since its inception the program has resulted in increased utilization

expenditures fell among the sizable group of Medicare Part D enrollees who previously had more generous coverage (Zhang et al. 2009; Lakdawalla and Yin 2015).[2]

To explore how Medicare Part D affected the retail pharmacy industry, we utilize 2000-2009 National Establishment Time-Series (NETS) data and a difference-in-differences identification strategy leveraging variation in the share of the local customer base that was presumably comprised of Medicare beneficiaries. The NETS provides us with establishment-level data on openings and closings, sales, and the number of employees (Currie et al. 2010; Neumark and Kolko 2010; Neumark et al. 2011; Orrenius et al. 2020). Meanwhile, our identification strategy compares changes occurring among pharmacies located in counties where adults aged 65 or older comprised an above-median share of the population in the year 2000 to the concurrent changes occurring among pharmacies located in below-median counties (Alpert et al. 2023).

We document several key findings. First, we show that the introduction of Medicare Part D was associated with a 5 percent reduction in the number of pharmacies located in counties where elderly adults comprised a larger share of the population. This finding is robust to a variety of specification choices, sample restrictions, and methods for conducting statistical inference. Additionally, we show that this reduction was more pronounced for racial and ethnic minority communities, suggesting that Medicare Part D may have widened existing disparities in pharmacy access. Event study analyses indicate that the change was not driven by a differential pre-trend, and the magnitude of post-period estimates is

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and decreased pharmacy gross margin rates as higher margin business (such as cash and state Medicaid customers) migrated to the new Part D coverage" (CVS 2007).

[2] Engelhardt and Gruber (2011) estimated in survey data that Medicare Part D resulted in 75 percent crowd-out of prescription-drug insurance coverage and expenditures of those aged 65 or older. Likewise, Lichtenberg and Sun (2007) estimate a 72 percent crowd-out rate for prescriptions using claims data from a large pharmacy chain.

consistent with the timing of Medicare Part D's implementation (Alpert 2016; Huh and Reif 2017). While we find evidence of reductions in both the number of standalone (i.e., non-chain) pharmacies and non-standalone pharmacies, the estimated reduction in the number of standalone pharmacies is 75 percent larger in magnitude.

Second, we show that the reduction in the number of pharmacies following the passage of Medicare Part D was driven by a reduction in the number of pharmacy openings. In contrast, we do not find any evidence that Medicare Part D was associated with increases in the number of pharmacy closures. Together, these patterns suggest that while Medicare Part D did not systematically put existing pharmacies out of business, it discouraged firm formation. As a result, we show that pharmacies located in counties where a higher share of the population was comprised of elderly adults subsequently faced a less competitive landscape than their counterparts in counties where elderly individuals comprised a smaller share of the population. These areas were increasingly serviced by incumbent firms that were approximately 3 percent older in the post-period. Using information on the GPS coordinates of each pharmacy, we then show that Medicare Part D was associated with a 5.3 to 6.4 percent reduction in the number of nearby pharmacies. As a result, pharmacies operating in locations that were the most competitive prior to the passage of Part D experienced a 2.7 to 4.9 percent increase in sales.

Finally, we provide evidence on the relationship between pharmacy access and mortality. Consistent with prior evidence (Huh and Reif 2017), we show that Medicare Part D was associated with an approximate 2 percent reduction in mortality for 66-year-olds relative to 64-year-olds. We then show that this reduction was driven by counties where elderly adults comprised a smaller share of the population. Within counties with an above-median share of the population comprised of elderly adults – where we uncovered a 5 percent reduction in the number of pharmacies – the mortality reduction is over 50 percent smaller in

magnitude and statistically insignificant. These patterns provide suggestive evidence that reduced pharmacy access dampened the mortality reductions attributable to Medicare Part D.

By providing the first quasi-experimental evidence that Medicare Part D reduced the size of the retail pharmacy industry, we contribute to a broad literature studying how government policies affect firm formation and competition (Reynolds et al. 1994; Acs and Szerb 2007; Shane 2009; Neumark and Kolko 2010; Lee et al. 2011; Figueroa-Armijos and Johnson 2016; Lu et al. 2019). Within the health care context, much of this work has focused on the causes (Gaynor et al. 2012; Avdic 2016; Aghamolla et al. 2024; Hollingsworth et al. 2024) and consequences (Kessler and McClellan 2000; Lindrooth et al. 2003; Buchmueller et al. 2006; Capps et al. 2010; Petek 2022) of changes in hospital competition. In contrast, there has been less work studying retail pharmacies, with some notable exceptions (Bennett and Yin 2019; Moura and Barros 2020; Janssen and Zhang 2023; Atal et al. 2024).[3]

The rest of the paper proceeds as follows: Section 2 describes the policy history of Medicare Part D, as well as the existing literature examining the effects of Medicare Part D on the health care industry and public health. Section 3 discusses the National Establishment Time-Series data that we use to study changes in business formation and firm performance, the National Vital Statistics data that we use to study changes in mortality, and our difference-in-differences identification strategy. Section 4 presents our results examining changes in the number of pharmacies in a county, pharmacy openings and closures, various

[3] Two of these papers have linked the entry of larger chains into a market to price reductions (Bennett and Yin 2019; Moura and Barros 2020). Meanwhile, Janssen and Zhang (2023) showed that independent pharmacies in the U.S. responded to competitive pressure by dispensing more prescription opioids. Finally, Atal et al. (2024) found that public pharmacy entry in Chile induced market segmentation and price increases in the private sector.

performance metrics for existing establishments, and health outcomes. Finally, Section 5 discusses the policy implications and limitations of our results.

2. Policy Background and Existing Literature

2.1 Policy Background

When Medicare was signed into law by President Lyndon B. Johnson in 1965, it was intended to protect senior citizens from financial devastation associated with hospital stays and certain medical procedures. Beneficiaries were automatically enrolled in hospital coverage (Medicare Part A), and coverage for physician services (Medicare Part B) was offered as optional, supplementary insurance. At that time, prescription benefits were not covered, though over the next forty years they became both more medically important and expensive (Duggan et al. 2008). By 2003, Medicare beneficiaries were spending an average of $2,500 per year on prescription drugs, or twice what the average American spent on health care in 1965 when adjusting for inflation (Engelhardt and Gruber 2011).

On December 8, 2003, President George W. Bush signed the Medicare Prescription Drug, Improvement, and Modernization Act of 2003, which created Medicare Part D. Though prescription drug benefits were not available until Part D was fully launched in 2006, the law established a transitional discount card program that became widely available in mid-2004. Medicare beneficiaries were free to sign up for Medicare Part D coverage until May 15, 2006, while those enrolling afterwards were subject to a financial penalty to mitigate adverse selection. However, beneficiaries eligible for both Medicare and Medicaid (i.e., "duals") were required to receive prescription benefits through Medicare (Basu et al. 2010; Abaluck and Gruber 2011). The law also included a low-income subsidy to help beneficiaries who could not otherwise afford the prescription drug benefit (Megellas 2006; Decarolis 2015).

Around the time of Part D's passage and implementation, retail pharmacy industry leaders predicted that the program would be somewhat dilutive to their performance as high-margin customers, including cash customers and individuals dual eligible for both Medicaid and Medicare, shifted to Part D plans (CVS 2006a; Walgreens 2006; Rite Aid 2007a).[4] While increased prescription drug utilization was projected to eventually offset the lower margin rates, the increases within the first years of the program were not large enough to fully offset the margin rate reduction at several large pharmacy chains (CVS 2006b; Rite Aid 2007b). However, because pharmacy sales made up only 60-70 percent of total sales at these larger chain pharmacies (CVS 2006a; Walgreens 2006; Rite Aid 2007a), their firmwide performance was less sensitive to the margin reduction than independent pharmacies who received over 90 percent of their revenue from prescriptions (NCPA Digest 2008).[5,6]

2.2 Existing Literature on Medicare Part D

We build on prior work studying the effects of Medicare Part D on the pharmaceutical industry. Leveraging variation across branded drugs in their pre-existing Medicare market share, Duggan and Scott Morton (2010) found that Medicare Part D increased drug utilization and reduced the growth in branded drug prices by up to 20 percent. Relatedly, Lakdawalla and Yin (2015) used variation in insurers' potential Part D enrollment and data from a national retail pharmacy chain to show that Part D enrollment increases lowered drug prices and reduced profits

[4] Prior work has shown that Medicaid reimbursement rates at this time were upwardly distorted (Duggan and Scott Morton 2006).

[5] Appendix Figure 1 plots independent pharmacies' average net operating income over time. There is an initial reduction coincident with Part D's passage and the movement to the transitional assistance programs and a more sizable reduction following Part D's full implementation in 2006.

[6] Another difference between CVS and independent pharmacies is that CVS includes both a retail pharmacy business and a pharmacy benefit manager (PBM) business. David Rickard concluded on the 2006 Q1 earnings call that Medicare Part D "was slightly dilutive to the retail business, slightly accretive to the PBM business, and slightly dilutive to the corporation overall" (CVS 2006c).

from individuals enrolled in commercial insurance plans external to Medicare Part D.

While Medicare Part D reduced drug prices, it also increased prescription drug utilization among those who previously lacked prescription drug coverage (Zhang et al. 2009; Kaestner and Khan 2012), as well as those who previously had less generous coverage (Yin et al. 2008; Engelhardt and Gruber 2011). For example, Lichtenberg and Sun (2007) used data from a large retail pharmacy chain and estimated that Medicare Part D reduced out-of-pocket costs for elderly adults by 18 percent and increased prescription drug utilization by nearly 13 percent, though Ketcham and Simon (2008) provide evidence that this sample may have understated the increase by 2.6 times compared to estimates obtained from a larger collection of pharmacies.

Several studies have also explored the ways in which Medicare Part D may have altered pharmaceutical manufacturers' strategic firm behaviors, such as innovation and advertising. Blume-Kohout and Sood (2013) found that Medicare Part D increased pharmaceutical research and development for therapeutic classes with higher Medicare market share, consistent with evidence that increases in market size (Kremer 2002; Acemoglu and Linn 2004) and government purchasing support (Finkelstein 2004) drive investment in research and development. Meanwhile, Lakdawalla et al. (2013) found that Medicare Part D resulted in a 14 to 19 percent increase in advertising expenditures, particularly among the least competitive drug classes, while Alpert et al. (2023) found that Medicare Part D led to larger increases in advertising in geographic areas with higher concentrations of Medicare beneficiaries. These results suggest that Medicare Part D increased the perceived return to advertising for pharmaceutical producers, though it is worth noting that the incentives faced by pharmaceutical manufacturers are not necessarily the same incentives faced by retail pharmacies.

We also build on work which has explored the relationship between Medicare Part D and patient outcomes. Using administrative Medicare data, Kaestner et al. (2019) found that gaining prescription drug coverage through Medicare Part D reduced hospital admissions by approximately 4 percent. Comparing changes in mortality among those eligible for Medicare Part D (i.e., those aged 66) to the concurrent changes among those whose age made them ineligible (i.e., those aged 64), Huh and Reif (2017) found that Medicare Part D reduced mortality by approximately 2 percent. Using a complementary research design leveraging pre-existing county-level differences in prescription drug coverage rates, Dunn and Shapiro (2019) similarly found that Medicare Part D reduced mortality.

Finally, we add to an interdisciplinary literature exploring the implications of Medicare Part D for retail pharmacies. Much of this work has used surveys and structured interviews to discern pharmacists' satisfaction with the program (Radford et al. 2007; Radford et al. 2009; Bono and Crawford 2010; Zhang et al. 2010; Khan 2012). In their responses, pharmacists regularly cited low reimbursement rates and increased administrative burdens as challenges, particularly for independent pharmacies. Relatedly, projections made shortly after Medicare Part D's implementation indicated that net income would fall by approximately 22 percent – attributable to a 0.7 percent decline in the gross margin for prescriptions (Carroll 2008). Examining descriptive trends in the number of pharmacies over time, Klepser et al. (2011) noted a nationwide increase in the number of independent pharmacy closures beginning in late 2007 through 2008, though they were unable to disentangle whether these changes were due to Medicare Part D or the start of the Great Recession.

We make several important contributions. While prior evidence suggests that Medicare Part D increased the profitability of prescription drugs for pharmaceutical companies (Friedman 2009), its effect on the retail pharmacy

industry is unclear. Moreover, much of the existing evidence is based on samples from a single large national pharmacy chain (Lichtenberg and Sun 2007; Yin et al. 2008; Lakdawalla and Yin 2015), though these data may not generalize to the entire industry (Ketcham and Simon 2008). As such, our ability to explore whether Medicare Part D was differentially related to changes in outcomes for the broader retail pharmacy industry is an important contribution. Additionally, adopting an industry-wide analysis allows us to study whether and how Medicare Part D has contributed to racial and ethnic health disparities in pharmacy access. Finally, we provide the first evidence on the connection between Medicare Part D-induced changes in the retail pharmacy industry and changes in patient outcomes.

3. Data and Methodology

3.1 National Establishment Time-Series

To examine how Medicare Part D affected the retail pharmacy industry, we use National Establishment Time-Series (NETS) data from 2000 through 2009. The NETS is a longitudinal dataset sourced from the Dun & Bradstreet Duns Marketing Information file tracking outcomes and characteristics of over 60 million business establishments in the United States. The data report when each establishment opened, when the establishment exited the data due to closure, as well as each establishment's annual sales, number of employees, and location. Importantly, the NETS also contains Standard Industrial Classification (SIC) codes, which allow us to identify retail pharmacies (SIC 5912). The NETS data have previously been used by researchers to explore a variety of topics related to business performance (e.g., Currie et al. 2010; Neumark and Kolko 2010; Neumark et al. 2011; Kolko 2012; Orrenius et al. 2020; Carpenter et al. 2023).

Table 1 provides summary statistics for the outcomes of interest and covariates.[7] To ensure that our results are not driven by changes in the composition of counties contributing to identification, we restrict our analyses to a balanced county-year panel. Column 1 reports summary statistics for the full sample. Column 2 reports statistics for counties that had a below-median elderly population in the year 2000 (i.e., counties where elderly adults presumably comprised a smaller share of the customer base). Likewise, column 3 reports statistics for establishments located in counties that had an above-median elderly population in the year 2000 (i.e., counties where elderly adults presumably comprised a larger share of the customer base). Panel A reports statistics for outcomes measured at the county level, including the number of pharmacies, the number of pharmacy openings, and the number of pharmacy closures. Panel B reports statistics for outcomes measured at the establishment level, including pharmacy sales and the number of pharmacy employees. On average, we see that counties that had a below-median elderly population in the year 2000 had considerably more pharmacies than counties where a higher share of the population was comprised of elderly adults (26.47 vs. 9.36). One explanation for this is that these younger counties were also considerably larger. When we examine the number of pharmacies per 100,000 individuals within each county, we find that counties where an above-median share of the population was comprised of elderly adults in the year 2000 had more pharmacies per 100,000 people than the below-median counties (18.84 vs. 27.19).

To examine the relationship between Medicare Part D and changes in the number of retail pharmacies, we leverage variation in the share of the county population comprised of elderly individuals through a difference-in-differences identification strategy (Alpert et al. 2023). The intuition behind this empirical

[7] We report summary statistics for the covariates in Appendix Table 1. We obtain data on county-level unemployment rates from the U.S. Bureau of Labor Statistics and county-level population from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program.

decision is that Medicare beneficiaries are more likely to make up a greater share of the customer base in counties with relatively older populations. Specifically, we estimate:

$$Y_{cst} = \alpha + \beta \cdot \mathbf{1}\{\text{ABOVE-MEDIAN SHARE}\}_c \times \mathbf{1}\{\text{Year} \geq 2004\}_t + \mathbf{X}'_{cst}\lambda + \theta_c + \tau_{st} + \varepsilon_{cst} \quad (1)$$

where the dependent variable, Y_{cst}, is the number of pharmacies in county *c* located in state *s* in year *t*. We also examine changes in the number of pharmacy openings and closings. To model the count nature of these data, we estimate equation (1) using a Poisson regression. As such, β measures the change in the natural log of our outcomes of interest.

Our coefficient of interest, β, measures how Medicare Part D differentially affected pharmacy outcomes based on whether the customer base was likely comprised of elderly adults by interacting a variable indicating that the county had an above-median share of the population comprised of adults aged 65 or older in the year 2000, $\mathbf{1}\{\text{ABOVE-MEDIAN SHARE}\}_c$, with a post-period indicator, $\mathbf{1}\{\text{Year} \geq 2004\}_t$. We begin our post-period in 2004 to account for the passage of the Medicare Prescription Drug, Improvement, and Modernization Act in December 2003. While Part D was not fully implemented until January 2006, beginning our post-period in 2004 accounts for interim programs intended to bridge the gap between passage and implementation (Huh and Reif 2017) and anticipatory changes in business decisions and drug utilization (Alpert 2016).[8]

We include a vector of county-level economic and demographic characteristics, $\mathbf{X}_{cst}$, to account for time-varying factors that may affect pharmacy outcomes independent of Medicare Part D. These include the county-level

[8] The Medicare Drug Discount Card and Transitional Assistance Programs began offering prescription discount cards in mid-2004 and provided $1.5 billion on prescription drug subsidies for low-income elderly adults (Huh and Reif 2017). Moreover, Alpert (2016) showed that patients reduced drug utilization for chronic but not acute conditions between Medicare Part D's passage and implementation.

unemployment rate, the natural log of the county population, the share of the county comprised of Black individuals, and the share of the county comprised of Hispanic individuals. We account for time-invariant county-level characteristics through the inclusion of county fixed effects, θ_c. Finally, we account for time-varying state-level policies and economic trends through the inclusion of state-by-year fixed effects, τ_{st}. Standard errors are clustered at the county level (Bertrand et al. 2004).

In the presence of our covariates and fixed effects, our identification assumption is that the number of pharmacies in counties with an above-median share of elderly individuals would have evolved similarly to the number of pharmacies in counties with a below-median share. While fundamentally untestable, we assess the validity of this assumption with the following event study specification:

$$Y_{cst} = \alpha + \sum_{t=2000,\, t\neq 2003}^{2009} \beta^t \cdot \mathbf{1}\{\text{ABOVE-MEDIAN SHARE}\}_c \times \mathbf{1}\{\text{Year} = t\}_t + \mathbf{X}'_{cst}\lambda + \theta_c + \tau_{st} + \varepsilon_{cst} \quad (2)$$

where the coefficients of interest, β^t, measure the evolution of pharmacy outcomes in counties with an above-median concentration of elderly individuals in the year 2000 relative to those counties with a lower concentration. In addition to allowing us to examine differential trends in the pre-period, this specification allows us to model potential dynamic treatment effects.

After exploring the relationship between Medicare Part D and the number of retail pharmacies, we turn our attention to changes in establishment-level outcomes for pharmacies conditional on being open using the following specification:

$$\ln(Y)_{icst} = \alpha + \beta \cdot \mathbf{1}\{\text{ABOVE-MEDIAN SHARE}\}_c \times \mathbf{1}\{\text{Year} \geq 2004\}_t + \mathbf{X}'_{cst}\lambda + \theta_i + \tau_{st} + \varepsilon_{icst} \quad (3)$$

where our dependent variables of interest are the natural log of sales and the natural log of the number of employees for pharmacy *i* located in county *c* in state *s* in year *t*. Annual sales and the number of employees are strictly positive for all pharmacies,

so we can take the natural log of these values (Mullahy and Norton 2023; Chen and Roth 2024), and we estimate equation (3) via ordinary least squares. Another difference, relative to equation (1), is that we account for all time-invariant pharmacy-specific characteristics by including establishment fixed effects. The inclusion of these additional fixed effects means that the estimates will be identified from within-establishment changes in the outcomes over time conditional on being open.

3.2 National Vital Statistics Mortality Files

Prior work found that Medicare Part D was associated with a reduction in deaths for 66-year-old adults relative to 64-year-old adults (Huh and Reif 2017). To study whether this relationship varied by changes in pharmacy access, we use mortality data for 2000-2009 from the National Vital Statistics System of the National Center for Health Statistics.[9] The Vital Statistics data provide us with information on the number of county-level deaths in a given year for each age. Using these data, we estimate the following equation:

$$Y_{acst} = \alpha + \beta \cdot \mathbf{1}\{\text{AGE} = 66\}_a \times \mathbf{1}\{\text{Year} \geq 2004\}_t + \mathbf{X}'_{cst}\lambda + \theta_{ac} + \tau_{st} + \varepsilon_{acst} \quad (4)$$

where the dependent variable, Y_{cat}, is the number of deaths for age a in county c in state s in year t. Our coefficient of interest, β, measures whether 66-year-olds experienced a differential mortality reduction relative to their 64-year-old counterparts following the passage of Medicare Part D. Our covariates are the same as the prior specifications with two exceptions. First, the vector $\mathbf{X}_{cst}$ includes the natural log of the county-level population of interest (i.e., the number of 66-year-olds or the number of 64-year-olds). Second, we include age-by-county fixed effects, θ_{ac}, to capture time-invariant county-level differences in mortality for 66-year-olds relative to 64-year-olds.

[9] We report summary statistics in Appendix Table 2.

Finally, we test whether the relationship between Medicare Part D and mortality varied by the share of the local population was comprised of Medicare beneficiaries in the pre-period. We estimate the following triple-difference equation:

$$Y_{acst} = \alpha + \beta \cdot \mathbf{1}\{\text{AGE} = 66\}_a \times \mathbf{1}\{\text{Year} \geq 2004\}_t \times \mathbf{1}\{\text{ABOVE-MEDIAN SHARE}\}_c + \mathbf{X}'_{cst}\lambda + \theta_{aa} + \eta_{ct} + \delta_{at} + \varepsilon_{acst} \quad (5)$$

where we now include age-by-county fixed effects, θ_{ac}, county-by-year fixed effects, η_{ct}, and age-by-year fixed effects, δ_{at}. Our coefficient of interest, β, captures the unique change in mortality for 66-year-old individuals relative to 64-year-old individuals after the passage of Medicare Part D in counties where an above-median share of the population was comprised of elderly adults in the year 2000.

4. Results

4.1 Effect on the Number of Pharmacies

We begin by examining the relationship between the introduction of Medicare Part D and changes in the size of the retail pharmacy industry. The dependent variable in Table 2 is the number of pharmacies in a county, and we estimate equation (1) as a Poisson model. Column 1 reports the results from a sparse specification including only county and year fixed effects. Column 2 augments this specification with the share of the county population comprised of Black individuals, the share of the county population comprised of Hispanic individuals, and the natural log of the county population. Column 3 accounts for local economic conditions by further including the county-level unemployment rate. Finally, column 4 accounts for state-level time-varying policies and conditions through the inclusion of state-by-year fixed effects. Across all columns, we find that Medicare Part D was associated with a statistically significant 5.3 to 8.3 percent reduction in the number of pharmacies.

Our static difference-in-differences estimate indicates that Medicare Part D reduced the number of retail pharmacies in areas where the customer base was presumably more likely to be comprised of elderly adults. Reassuringly, the dynamic event study estimates in Figure 1 suggest that this reduction was not driven by an existing difference in pharmacy availability. The pre-period estimates are small in magnitude, do not display any downward trend, and are statistically insignificant. Instead, we estimate that the number of pharmacies initially fell by 1.1 to 4.3 percent in the years following Part D's passage but prior to its full implementation.[10] This reduction increased in magnitude following full implementation, such that counties that had a higher share of the population comprised of elderly adults in the year 2000 experienced a 5.9 to 7.7 percent reduction in the number of pharmacies relative to the relatively younger comparison counties.

To further increase confidence that we are detecting a meaningful relationship between Medicare Part D and a reduction in the number of pharmacies, we adopt a variant of Fisher's (1935) permutation test. First, we match each county to another random county's population share in the year 2000. Second, we re-estimate equation (1) and save the resulting coefficient. After repeating this process 100 times, we compare the actual estimate to the distribution of these placebo coefficients (Buchmueller et al. 2011; Cunningham and Shah 2018; Churchill 2021). Figure 3 shows that the reduction in the number of pharmacies we estimate as being attributable to the passage of Medicare Part D is well outside of the placebo distribution, indicating that we are unlikely to have obtained this value by chance.[11]

In Appendix Table 4 we show that these results are robust to alternative ways of defining the treatment group, including separating counties into quartiles

[10] We report these estimates and tests of joint significance in Appendix Table 3.

[11] Appendix Figure 2 plots the coefficient and corresponding confidence intervals for the actual result (dark grey triangle) and the 100 placebo results (light grey circles).

based on the share of the population comprised of elderly adults in the year 2000 (column 2) and using the continuous population share (column 3). Meanwhile, we show in Appendix Figure 3 that the results are robust to excluding the smallest and largest pharmacies from the data.[12] Likewise, Appendix Figure 4 shows that the results are robust to iteratively excluding observations from each state, alleviating concerns that our results are driven by states with largest shares of older adults, such as Arizona and Florida.

As previously discussed, patients who are dual eligible for both Medicaid and Medicare are required to obtain prescription drug coverage through a Part D plan. Shortly after Medicare Part D's implementation, industry leaders at large chain pharmacies indicated that this shift was adversely affecting their margins (CVS 2006a; Walgreens 2006; Rite Aid 2007a). Likewise, the gross margin for claims dispensed at independent pharmacies was 20-30 percent smaller under Part D plans (Reisetter et al. 2006; Carroll 2008; Winegar et al. 2009). One explanation for this reduction is that patients were shifting from a relatively inelastic purchaser (i.e., the state) where prices were upwardly distorted (Duggan and Scott Morton 2006) to a more elastic Part D plan, and Duggan and Scott Morton (2010) showed this shift reduced drug prices by nearly 20 percent.

If the estimated reduction in the number of pharmacies is due to Part D's relatively lower reimbursement rates, we would expect to detect a larger reduction in areas with a greater concentration of dual eligible beneficiaries. To test this possibility, in Table 3 we fully interact our right-hand side variables with an indicator for whether the county had an above-median county-level poverty rate in

[12] Prior work suggests that the establishment-specific NETS data may be less reliable for the largest and smallest establishments (Neumark et al. 2005; Barnatchez et al. 2017), particularly establishments with fewer than five employees. While this measurement issue is less of a concern when examining whether the firm exists – relative to studying changes in sales and the number of employees – we follow Barnatchez et al.'s (2017) recommendation and set the lower bounds at 5 and 10 employees. We set the upper bound at 34 employees to exclude pharmacies in the top 5 percent of the employment distribution.

the year 2000 (column 1). Medicare Part D was associated with a 3.4 percent reduction in the number of pharmacies in counties that had an above-median share of the population comprised of elderly adults in the year 2000 compared to below-median counties. However, in counties that also had an above-median share of the population living in poverty, we estimate a larger 8.2 percent reduction (-0.034 - 0.048 = -0.082).

Prior work has shown that racial and ethnic minority communities have limited access to retail pharmacies compared to non-minoritized communities (Essien et al. 2021; Guadamuz et al. 2021; Guadamuz et al. 2024). In Table 3, we explore whether Medicare Part D inadvertently widened this disparity by fully interacting the right-hand side variables with an indicator for whether the county had an above-median share of the population comprised of Asian, Black, Hispanic, and Other Race/Ethnicity individuals in the year 2000 (column 2). We find that Medicare Part D was associated with a larger reduction in the number of pharmacies in more racially diverse counties. Specifically, we estimate a 2.0 percent reduction in the less racially diverse counties and a 6.1 percent reduction in the most racially diverse counties (-0.020 - 0.041 = -0.061). Finally, despite concerns that Medicare Part D would disproportionately harm pharmacies located within rural communities (Radford et al. 2007; Radford et al. 2009; Klepser et al. 2011), we do not detect any evidence that Medicare Part D was associated with a larger reduction in the number of pharmacies in rural counties relative to non-rural counties (column 3).

At the time of Medicare Part D's passage, there were concerns that independent pharmacies would be put at a disadvantage relative to chain establishments. Independent pharmacies tend to operate on smaller margins than their chain counterparts (Berndt and Newhouse 2010), and the average independent pharmacy receives a higher share of its revenue from prescription drug sales than chain pharmacies (Spooner 2008; Weigel et al. 2013). As a result, independent pharmacies were thought to be particularly vulnerable to reimbursement changes,

such as individuals shifting from being high-margin cash customers to those with insurance or dual eligible individuals shifting from Medicaid to Medicare Part D. In Table 4, we leverage the fact that the NETS includes information about whether the observation is a standalone (i.e., non-chain) establishment or a non-standalone establishment. Column 1 shows that Medicare Part D was associated with a 7.7 percent reduction in the number of standalone pharmacies and a 4.0 percent reduction in the number of non-standalone pharmacies. These results suggest that the concerns that Medicare Part D would be particularly detrimental to independent pharmacies was justified.

4.2 Effect on Openings and Closures

We have found clear evidence that Medicare Part D was associated with a reduction in the number of pharmacies in counties where elderly individuals were more likely to comprise a larger share of the customer base. In Table 5, we now explore whether these changes were attributable to a reduction in the number of new pharmacy openings and/or an increase in the number of pharmacy closures. We find that Medicare Part D was associated with a statistically significant 8.8 percent reduction in the number of new pharmacy openings (column 1). In contrast, the relationship between Medicare Part D and closures is nearly 90 percent smaller in magnitude and statistically insignificant. Together, these results suggest that while Medicare Part D shrank the pharmacy industry in counties where elderly adults were more likely to comprise a larger share of the customer base, it did so primarily by discouraging the formation of new businesses, rather than by closing existing pharmacies.

In Figure 3, we use our event study specification to explore the dynamic relationships between Medicare Part D, pharmacy openings (Panel A), and pharmacy closures (Panel B).[13] Prior to the passage of Medicare Part D, there is no

[13] These estimates are also reported in Appendix Table 3.

evidence that pharmacy openings were differentially trending in counties where elderly individuals comprised an above-median share of the population relative to counties where they comprised a below-median share of the population. Although we estimate sizable reductions in the number of pharmacy openings in the three years following passage of Medicare Part D, we do not detect any change in the subsequent years. Because the reduction in the number of openings largely occurred prior to Part D's implementation, this pattern suggests that the reduction in openings may have been driven by uncertainty regarding program implementation and subsequent changes in profitability. Yet even though this uncertainty should have been resolved after Part D was fully implemented, we do not detect any increase in openings to offset the temporary decline.

As with our results examining changes in the number of pharmacies, we show in Appendix Table 5 that the reduction in the number of openings is robust to alternative ways of defining treatment status, including based on the quartile of the elder share population and using a continuous measure. Similarly, we show in Appendix Table 6 that patterns are robust to excluding the openings and closures of the smallest and largest establishments, while Appendix Figure 5 shows that the results are robust to the randomization placebo test.[14]

4.3 Effects on Pharmacy Age, Sales, and Employment

In the prior section, we showed that, after the passage of Medicare Part D, counties where elderly individuals likely comprised a larger share of the customer base saw a reduction in the number of pharmacies compared to counties where they likely

[14] Appendix Table 7 shows that Medicare Part D was associated with an 11.1 percent reduction in the number of standalone pharmacy openings (Panel A column 1) without any statistically significant change for non-standalone pharmacies (Panel A column 2). There is less consistent evidence for pharmacy closures. For standalone pharmacies, the point estimate is negative and statistically significant at the ten percent level (Panel B column 1), which is consistent with predictions that many existing independent pharmacies would remain profitable (Carroll 2008). However, we also estimate an increase in the number of non-standalone pharmacy closures (Panel B column 2).

comprised a smaller share. We now explore the consequences of these changes for individual pharmacies using the establishment-level NETS data. Consistent with our prior results showing that Medicare Part D reduced the number of new entrants into the retail pharmacy market, Figure 4 shows that the pharmacies within these counties were increasingly older incumbent establishments.[15] We estimate that Part D was associated with an approximate 3 percent increase in pharmacy age. Next, we test whether pharmacies that operated within these counties faced a less dynamic competitive landscape.

An important feature of the NETS database is that it includes the GPS coordinates of each establishment. While there is no standard definition of what constitutes a retail pharmacy market area (Chen 2019; Starc and Swanson 2021; Janssen and Zhang 2023; Atal et al. 2024), Medicare Part D's retail pharmacy "network adequacy" standards require that 90 percent of urban beneficiaries reside within 2 miles of a network pharmacy, 90 percent of suburban beneficiaries reside within 5 miles, and 70 percent of rural beneficiaries reside within 15 miles (Centers for Medicare and Medicaid Studies 2006). Based on these standards, for each pharmacy we determine the number of pharmacies located within a 1-kilometer radius (~0.62 miles), a 5-kilometer radius (~3.1 miles), and a 10-kilometer radius (~6.2 miles).[16]

Figure 5 plots the estimates from a Poisson regression including our time-varying right-hand side covariates, establishment-level fixed effects, and state-by-year fixed effects. Consistent with our results showing a reduction in the number of pharmacies within the county, we find that Medicare Part D was associated with a

[15] We obtain these results from the Poisson specification shown in equation (2) that includes our right-hand side time-varying controls, county fixed effects, and state-by-year fixed effects. We do not include establishment-level fixed effects because these – in conjunction with the time fixed effects – would be collinear with pharmacy age.

[16] We report summary statistics for these measures in Appendix Table 8.

5.3 to 6.4 percent reduction in the number of nearby pharmacies.[17] To test whether this reduction varied by the existing level of competitive pressure, we utilize the distribution of the number of nearby pharmacies in 2003 prior to the passage of Medicare Part D. We classify locations in the bottom quartile of this distribution as being in a "low-competition area," those in the middle 50 percent of the distribution as being in a "moderate-competition area," and those in the top quartile of the distribution as being in a "high-competition area." We show in Table 6 that Medicare Part D was associated with an across-the-board reduction in the level of competition.

In Table 7, we explore whether Medicare Part D affected pharmacy performance. Panel A examines county-level changes in sales and employment, while Panel B examines changes at establishments conditional on being open (i.e., the outcomes are measured at the establishment level and the regressions include establishment fixed effects). Consistent with evidence showing a reduction in the number of retail pharmacies, we find that counties which had a greater share of the population comprised of elderly adults in the year 2000 experienced a 4.5 percent reduction in pharmacy sales (Panel A column 1) and a 2.4 percent reduction in the number of pharmacy employees (Panel A column 2) following the passage of Medicare Part D. However, conditional on being open, we find no evidence that Medicare Part D was associated with changes in pharmacy sales (Panel B column 1) or employment (Panel B column 2).[18]

[17] Appendix Figure 6 shows that these reductions were limited to the post-period.

[18] Appendix Table 9 shows that the county-level reductions were most pronounced for standalone pharmacies and offers evidence that, conditional on remaining open, standalone pharmacies saw increases in sales following the passage of Medicare Part D. Indeed, Appendix Figure 7 shows that standalone pharmacies that were open throughout the sample period saw increases in sales and employment in the post-period. Appendix Table 10 shows that these patterns are robust to alternative ways of specifying the independent variable, and Appendix Table 11 suggests that the relationship is robust to excluding the smallest and largest establishments (Neumark et al. 2005; Barnatchez et al. 2017). However, these latter estimates are less-precisely estimated because when we limit the sample to standalone pharmacies with between 5 and 34 employees the sample is approximately 50

Given that Medicare Part D reduced the number of pharmacies, it is possible that pharmacies were able to improve their business outcomes, particularly for those located in what otherwise would have been more competitive areas. We explore this possibility in Figure 6 by examining changes in the natural log of annual sales (Panel A) and the number of employees (Panel B) based on whether the pharmacy was in a low-competition, medium-competition, or high-competition area. Regardless of the radius used to define the market area, we find that Medicare Part D was associated with a 2.7 to 4.9 percent increase in annual sales for pharmacies located in areas with the highest levels of competition prior to the passage of Medicare Part D.[19] Notably, we do not detect any changes in sales for pharmacies located in low-competition areas and medium-competition areas, suggesting that Medicare Part D primarily improved business outcomes by reducing competition.

4.4 Effects on Mortality

Huh and Reif (2017) found that Medicare Part D was associated with an approximate 2 percent reduction in mortality for 66-year-olds relative to 64-year-olds. Given our findings that Medicare Part D was associated with a reduction in the number of pharmacies in counties where Medicare beneficiaries likely made up a larger share of the customer base, it is possible that these health benefits were at least partially dampened by changes in pharmacy access. While changes in the number of pharmacies may have affected mortality for both 66- and 64-year-old individuals, in Table 8 we test whether the differential improvement in mortality

percent smaller. When we limit the sample to standalone pharmacies with between 10 and 34 employees, the sample is nearly 85 percent smaller

[19] In Appendix Table 12 we show that our results showing a reduction in competition are robust to defining competition based on the volume of sales at nearby pharmacies, rather than the number of nearby pharmacies. Likewise, Appendix Figure 8 shows a similar pattern when defining low-competition, medium-competition, and high-competition areas based on the distribution of nearby pharmacy sales in 2003.

for 66-year-olds following the passage of Medicare Part D was attenuated using National Vital Statistics data and the difference-in-differences specification shown in equation (4).

In line with the prior evidence, we find that Medicare Part D was associated with a 1.7 percent reduction in mortality for 66-year-old adults relative to their 64-year-old counterparts (column 1). We also find suggestive evidence that this health improvement was smaller in the same counties where we detected a reduction in the number of pharmacies. In counties where elderly adults comprised a below-median share of the population, we estimate a statistically significant 2 percent reduction in the number of 66-year-old deaths compared to their 64-year-old counterparts (column 2). In contrast, in counties where elderly adults comprised an above-median share of the population the estimate is over 50 percent smaller in absolute magnitude and statistically insignificant (column 3). While our triple-difference estimate from equation (6) that includes age-by-year, county-by-age, and county-by-year fixed effects indicates that 66-year-old mortality was up to 1.6 percent higher in counties where Medicare beneficiaries likely made up a greater share of the customer base following the passage of Medicare Part D, the result is not statistically significant (column 4).[20] Appendix Figure 9 plots the event study analogue for our triple-difference specification. The estimates suggest that counties that had an above-median share of the population comprised of elderly adults in the year 2000 saw higher rates of 66-year-old mortality compared to 64-year-old mortality relative to below-median counties following the passage of Medicare Part D.

[20] In Appendix Table 13 we examine changes in mortality for men (column 1), women (column 2), white individuals (column 3), and Asian, Black, Hispanic, and all other race/ethnicity individuals (column 4). We find no evidence of mortality improvements in the counties that we showed also experienced a reduction in the number of pharmacies relative to the counterfactual (Panel B). Instead, the public health improvements are concentrated entirely in counties where Medicare beneficiaries comprised a smaller share of the customer base (Panel C).

5. Conclusion

Retail pharmacies play a key role in the U.S. health care system. In addition to dispensing prescription medication, pharmacies serve as sources of broader types of patient care, particularly for members of rural, low-income, and racial and ethnic minority communities (McConeghy and Wing 2016; Brownstein et al. 2022; Shakya et al. 2024; Smart et al. 2024). Yet the retail pharmacy industry has experienced significant challenges (Salako et al. 2018; Guadamuz et al. 2019), limiting access for groups vulnerable to health disparities (Essien et al. 2021; Guadamuz et al. 2024). Despite these industry-wide trends and their implications for patient welfare, relatively little is known about the factors driving retail pharmacy business performance.

In this paper, we study the relationship between Medicare Part D and retail pharmacy outcomes. While Medicare Part D increased prescription drug utilization among Medicare beneficiaries (Lichtenberg and Sun 2007; Ketcham and Simon 2008; Yin et al. 2008; Kaestner and Khan 2012), it also lowered pharmaceutical prices (Duggan and Scott Morton 2010; Duggan and Scott Morton 2011; Lakdawalla and Yin 2015) and imposed administrative costs on pharmacies (Spooner 2008; Radford et al. 2009). Using 2000-2009 National Establishment Time-Series data and a difference-in-differences identification strategy leveraging variation in the share of the local customer base presumably comprised of Medicare beneficiaries, we show that Medicare Part D was associated with a 5 percent reduction in the number of pharmacies located in counties where elderly adults comprised a larger share of the population. Next, we show that this reduction was larger for racial and ethnic minority communities, implying that Medicare Part D may have widened disparities in pharmacy access. We then show that this change was driven by a reduction in the number of pharmacy openings, while estimates for pharmacy closures are smaller in magnitude and statistically insignificant.

By reducing the number of new pharmacy openings, we show that Medicare Part D increased incumbency and lowered retail pharmacy competition. We show that Medicare Part D was associated with a 3 percent increase in establishment age. Using establishment-level data to examine within-pharmacy changes over time, we show that Medicare Part D was associated with a 5.3 to 6.4 percent reduction in the number of nearby pharmacies. As a result, we show that pharmacies located in the most competitive areas prior to the passage of Medicare Part D experienced a 2.7 to 4.9 percent increase in sales.

Finally, we offer suggestive evidence that the mortality reductions previously attributed to Medicare Part D (Huh and Reif 2017) were dampened by changes in retail pharmacy access. While we find that Medicare Part D was associated with a 2 percent reduction in 66-year-old deaths compared to 64-year-old deaths in counties where elderly adults comprised a smaller share of the population, the estimate for above-median counties is over 50 percent smaller in absolute magnitude and statistically insignificant.

This study is subject to some limitations. First, we are unable to directly identify the pathway through which Medicare Part D discouraged business formation (e.g., lower reimbursement rates, additional administrative burdens, etc.). While prior work has largely focused on demonstrating the degree to which Medicare Part D reduced pharmaceutical prices (Zhang et al. 2009; Lakdawalla and Yin 2015), identifying the relative importance of alternative channels remains an important area for future research. Second, because our sample period includes the years immediately following the introduction of Medicare Part D, we are unable to determine whether the estimated relationships have been affected by more recent health care reform efforts. The Inflation Reduction Act of 2022 included several provisions intended to lower prescription drug prices (Cubanski et al. 2023), and it will be important to study whether this reform similarly discourages growth in the retail pharmacy industry. Despite these limitations, this study provides important

new evidence that Medicare Part D has stunted growth of the retail pharmacy industry at a time when patients are more frequently turning to pharmacies as a source of preventive care.

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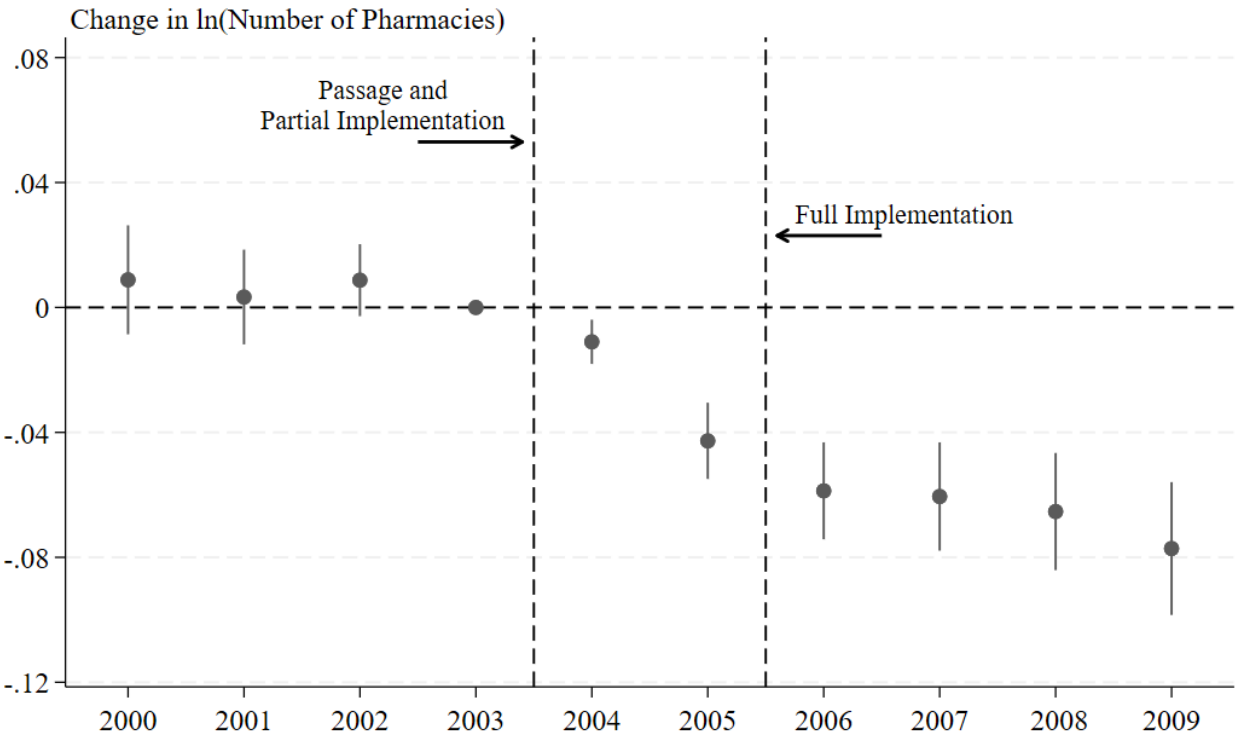
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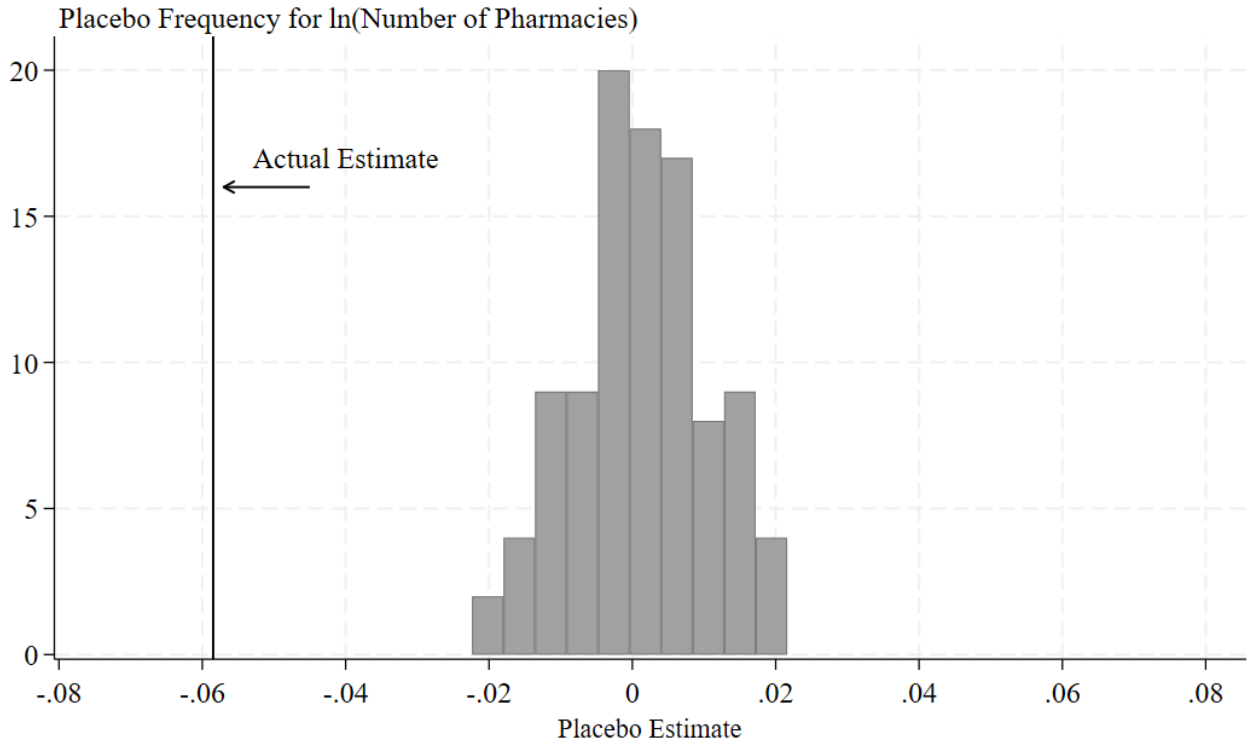
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Figure 1: Medicare Part D Was Associated with a Reduction in the Number of Pharmacies



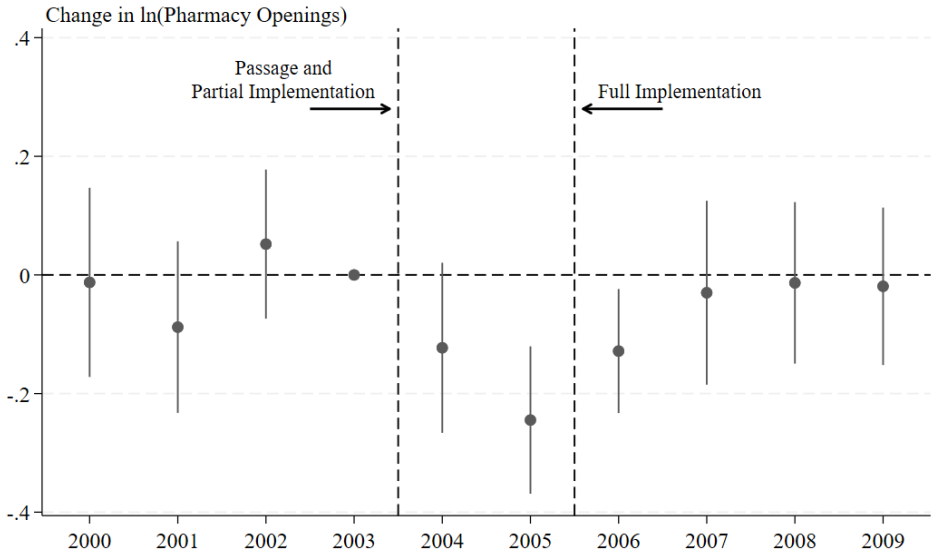
Source: National Establishment Time-Series, 2000-2009.
Note: The dependent variable is the number of pharmacies in a county. The grey circles indicate the coefficients and the vertical lines the 95 percent confidence intervals obtained from the event study specification shown in equation (2) comparing counties that had an above-median share of the population comprised of elderly adults in the year 2000 to counties that had a below-median share. The regression is estimated using a Poisson specification, so the results are interpreted as changes in natural log of the dependent variable. Standard errors are clustered at the county level.

Figure 2: The Relationship Between Medicare Part D and the Number of Pharmacies is Robust to Randomization Inference

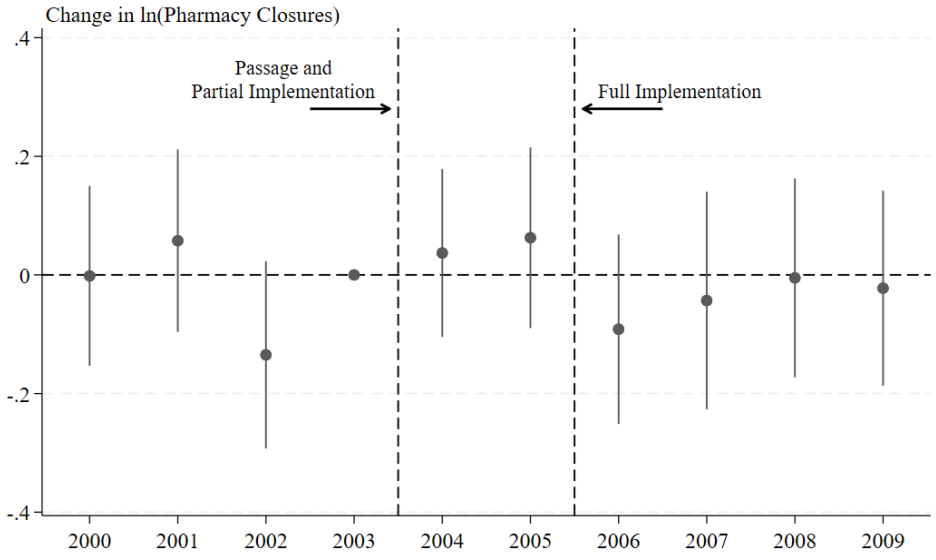


Source: National Establishment Time-Series, 2000-2009.
Note: The dependent variable is the number of pharmacies in a county. The independent variable of interest captures how the number of pharmacies changed following the passage of Medicare Part D in counties with an above-median share of the population comprised of elderly adults in the year 2000 relative to counties with a below-median share. The regressions include the full set of controls from equation (1). Because they are estimated via a Poisson specification, the results are interpreted as changes in natural log of the dependent variable. The histogram plots the distribution of placebo coefficients obtained from 100 iterations randomly matching each county to a county population share in the year 2000. These placebo estimates and their confidence intervals are also plotted in Appendix Figure 2. The estimate we use from the correct match between counties and their population shares, shown in the vertical black line, are outside the placebo distribution, indicating that the result was unlikely to have been obtained by chance.

Figure 3: Medicare Part D Was Associated with a Reduction in the Number of Pharmacy Openings



(A)

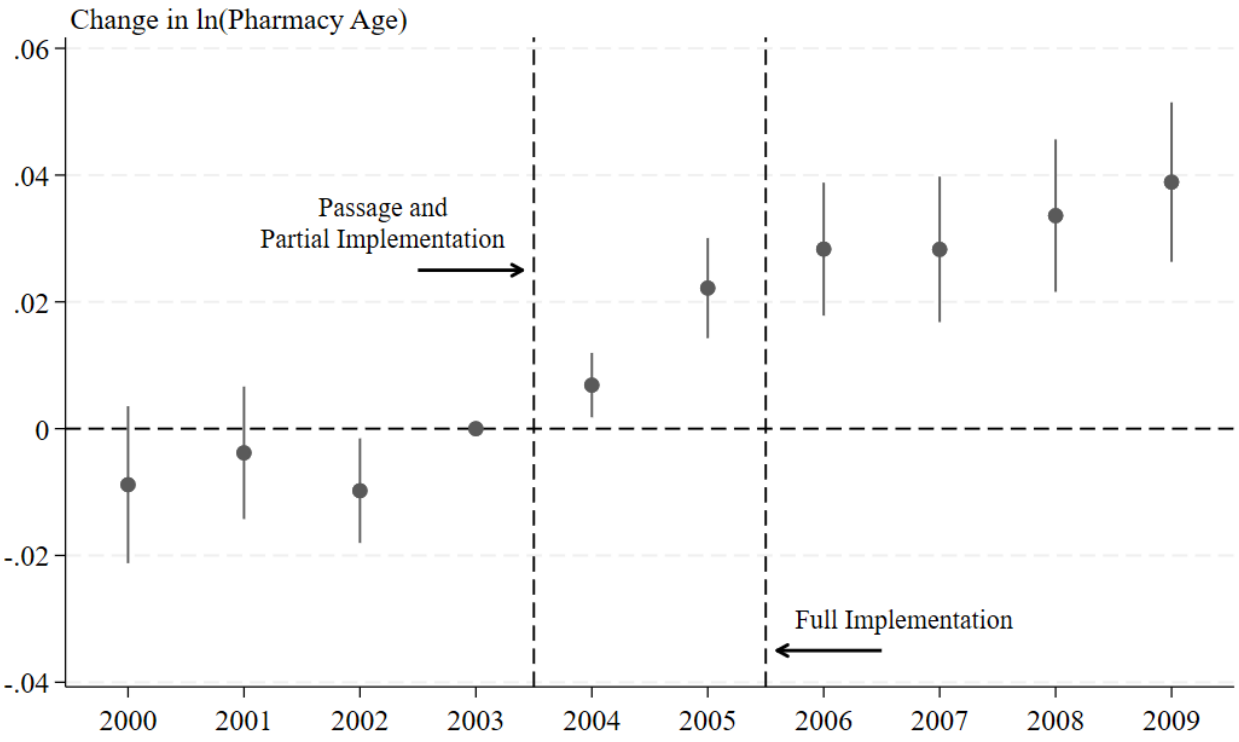


(B)

Source: National Establishment Time-Series, 2000-2009.

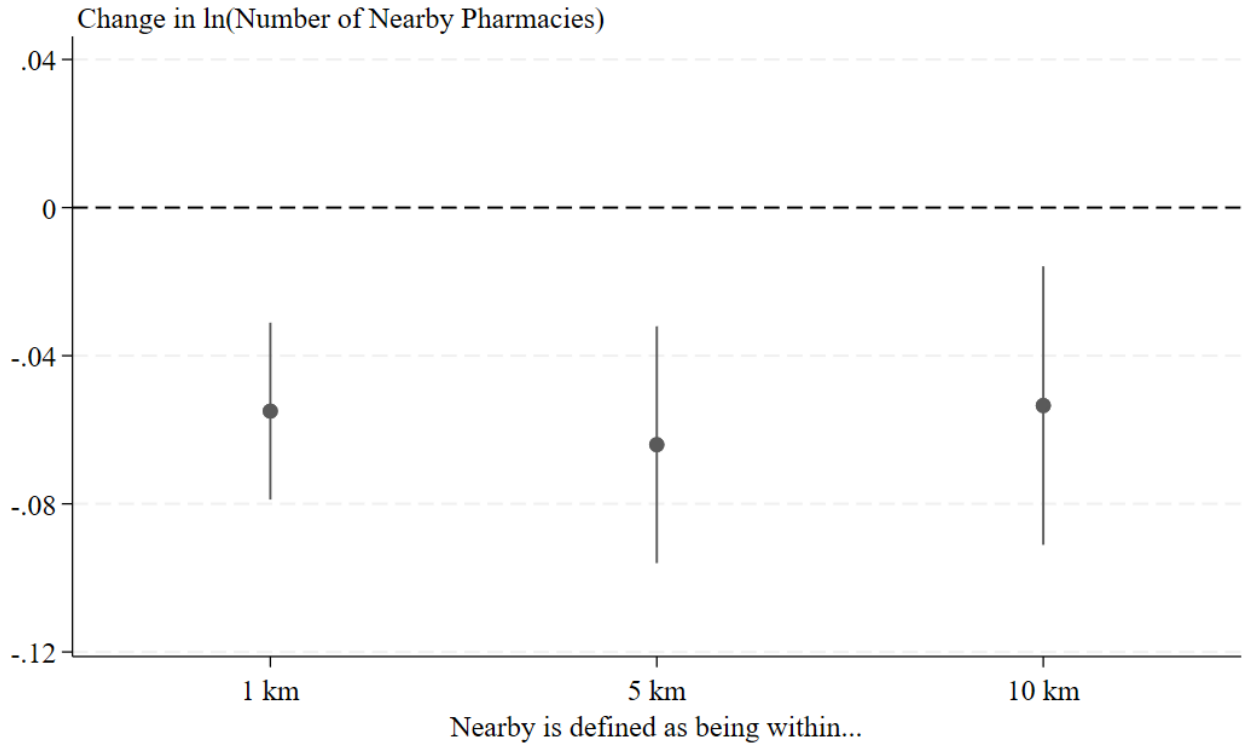
Note: The dependent variable in Panel A is the number of pharmacy openings in a county. The dependent variable in Panel B is the number of pharmacy closures in a county. The grey circles indicate the coefficients and the vertical lines the 95 percent confidence intervals obtained from the event study specification shown in equation (2) comparing counties that had an above-median share of the population comprised of elderly adults in the year 2000 to counties that had a below-median share. The regression is estimated using a Poisson specification, so the results are interpreted as changes in natural log of the dependent variable. Standard errors are clustered at the county level.

Figure 4: Medicare Part D Was Associated with an Increase in Pharmacy Age



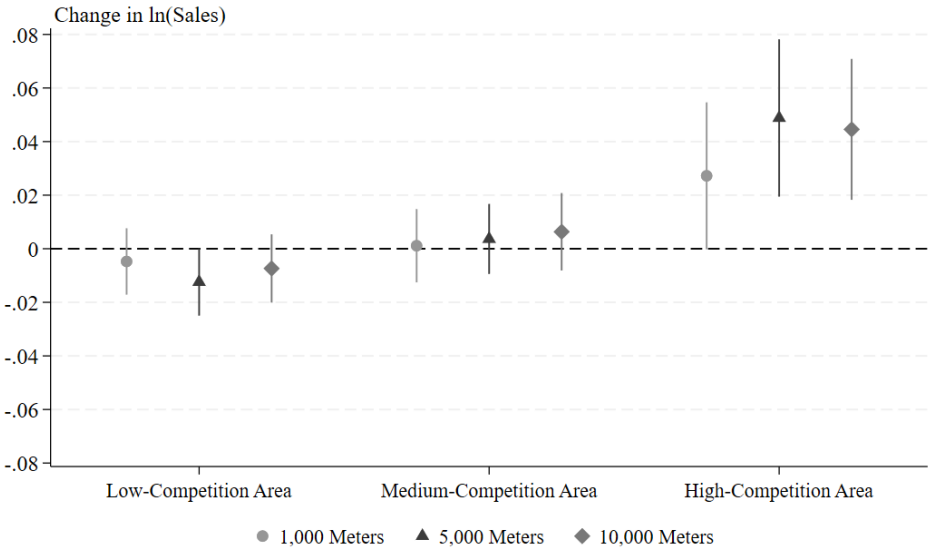
Source: National Establishment Time-Series, 2000-2009.
Note: The dependent variable is the age of the pharmacy. The grey circles indicate the coefficients and the vertical lines the 95 percent confidence intervals obtained from a modified version of the event study specification shown in equation (4) comparing counties that had an above-median share of the population comprised of elderly adults in the year 2000 to counties that had a below-median share. Rather than include establishment fixed effects, the regression utilizes county fixed effects and allows the composition of establishments contributing to identification to change over time capture changes in entry/exit. The regression is estimated using a Poisson specification, so the results are interpreted as changes in natural log of the dependent variable. Standard errors are clustered at the county level.

Figure 5: Pharmacies Had Fewer Nearby Competitors Following the Passage of Medicare Part D

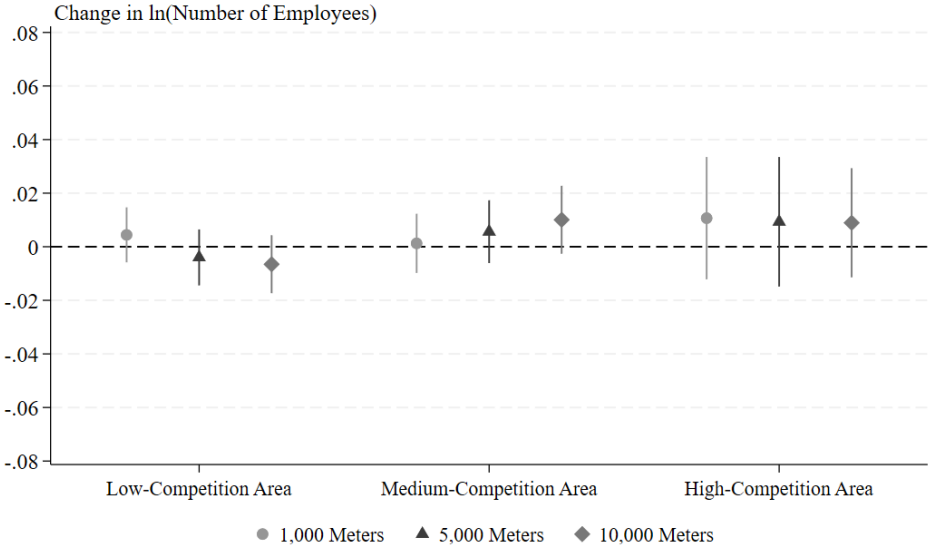


Source: National Establishment Time-Series, 2000-2009.
Note: The estimates are obtained from estimating equation (3). The dependent variable is the number of nearby pharmacies. The figure reports the results from three separate regressions where "nearby" is defined as the radius shown on the horizontal axis (i.e., within 1 kilometer, within 5 kilometers, and within 10 kilometers). Column 1 defines "nearby" as being within 1,000 meters, column 2 defines "nearby" as being within 5,000 meters, and column 3 defines "nearby" as being within 10,000 meters. The independent variable of interest is an indicator for the passage of Medicare Part D interacted with an indicator for whether the county had an above-median share of elderly adults in the year 2000. All columns include establishment and year fixed effects, county-level demographic and economic controls, and state-by-year fixed effects. Standard errors, shown in parentheses, are clustered at the county level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Figure 6: The Relationship Between Medicare Part D and Pharmacy Sales, by Competition Level Prior to Medicare Part D's Passage



(A)



(B)

Source: National Establishment Time-Series, 2000-2009.
Note: The dependent variable in Panel A is the natural log of sales, and the dependent variable in Panel B is the natural log of the number of employees. The independent variable of interest captures how the number of pharmacies changed following the passage of Medicare Part D in counties with an above-median share of the population comprised of elderly adults in the year 2000 relative to counties with a below-median share. The regressions include the full set of controls from equation (3). Each estimate is from a separate regression where the sample is limited to establishments in low, medium, or high competition areas in the year 2003. The light grey circles denote results where we define a competition area using a 1,000-meter radius, the dark grey triangles denote results where we define a competition area using a 5,000-meter radius, and the grey diamonds denote results where we define a competition area using a 10,000-meter radius. Standard errors are clustered at the county level.

Table 1: Summary Statistics

	(1)	(2)	(3)
Sample →	Overall	Below-Median Share	Above-Median Share
Panel A: County-Level			
Pharmacies	17.98	26.47	9.36
	(58.05)	(76.87)	(25.48)
Openings	1.32	2.06	0.56
	(5.85)	(7.77)	(2.57)
Closures	0.74	1.12	0.36
	(2.68)	(3.48)	(1.38)
Pharmacies per 100K	22.99	18.84	27.19
	(13.78)	(9.17)	(16.19)
Openings per 100K	1.05	1.08	1.02
	(2.68)	(1.98)	(3.24)
Closures per 100K	0.74	0.70	0.79
	(2.24)	(1.60)	(2.74)
Observations	29,340	14,770	14,570
Panel B: Establishment-Level			
Sales	$3,308,615	$3,425,410	$2,973,699
	($10,969,813)	($11,908,122)	($7,657,009)
Employees	13.13	13.42	12.30
	(44.91)	(47.01)	(38.27)
Sales per 100K	$2,716,756	$1,764,234	$5,448,152
	($10,515,862)	($6,070,284)	($17,662,418)
Employees per 100K	11.74	7.28	24.53
	(59.86)	(28.11)	(106.63)
Observations	527,401	391,035	136,366

Source: National Establishment Time-Series, 2000-2009.
Note: The table reports the sample mean and standard deviations (in parentheses).

Table 2: Medicare Part D was Associated with a Reduction in the Number of Retail Pharmacies in Counties with an Above-Median Elderly Population in the Year 2000

	(1)	(2)	(3)	(4)
1{Year ≥ 2004} ×	-0.083***	-0.053***	-0.054***	-0.058***
1{High Share 65+ in 2000}	(0.017)	(0.015)	(0.015)	(0.009)
Psuedo-R^2	0.918	0.919	0.919	0.919
Observations	29,340	29,340	29,340	29,340
County & Year FE?	Y	Y	Y	Y
County Demographics?		Y	Y	Y
County Unemployment Rate?			Y	Y
State-by-Year FE?				Y

Source: National Establishment Time-Series, 2000-2009.

Note: The estimates are obtained via the Poisson specification shown in equation (1). The dependent variable is the number of pharmacies in a county. The independent variable of interest is an indicator for the passage of Medicare Part D interacted with an indicator for whether the county had an above-median share of elderly adults in the year 2000. Column 1 includes county and year fixed effects. County 2 further includes county-level demographic characteristics, including the natural log of the county population, the share of the county population comprised of Black individuals, and the share of the county population comprised of Hispanic individuals. Column 3 further includes controls for the county-level unemployment rate. Finally, column 4 includes state-by-year fixed effects. Because they are estimated via a Poisson specification, the results are interpreted as changes in natural log of the dependent variable. Standard errors, shown in parentheses, are clustered at the county level.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 3: Medicare Part D was Associated with a Larger Reduction in the Number of Pharmacies in Racial and Ethnic Minority Communities and in Poorer Communities

	(1)	(2)	(3)
1{Year ≥ 2004} ×	-0.034***	-0.020*	-0.047***
1{High Share 65+ in 2000}	(0.012)	(0.011)	(0.011)
1{Year ≥ 2004} ×	-0.048***		
1{High Share 65+ in 2000} ×	(0.018)		
1{High Share Poverty in 2000}			
1{Year ≥ 2004} ×		-0.041**	
1{High Share 65+ in 2000} ×		(0.017)	
1{High Share Non-White in 2000}			
1{Year ≥ 2004} ×			0.026
1{High Share 65+ in 2000} ×			(0.019)
1{Rural Counties}			
Psuedo-R^2	0.919	0.919	0.919
Observations	29,340	29,340	29,340

Source: National Establishment Time-Series, 2000-2009.
Note: The estimates are obtained via a modified version of Poisson specification shown in equation (1) that fully interacts all the right-hand side variables with an indicator for being in a particular group of interest. In column 1 the indicator denotes whether the county had an above-median share of the population living in poverty in the year 2000, in column 2 the indicators denotes whether the county had an above-median share of the population comprised of Asian, Black, Hispanic, and all other non-white individuals in the year 2000, and in column 3 the indicator denotes whether the county is rural (i.e., "noncore"). The dependent variable is the number of pharmacies in a county. All columns include county and year fixed effects, county-level demographic and economic controls, and state-by-year fixed effects that are interacted with the indicator of interest. Because they are estimated via a Poisson specification, the results are interpreted as changes in natural log of the dependent variable. Standard errors, shown in parentheses, are clustered at the county level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 4: Medicare Part D was Associated with a Reduction in Both Standalone and Non-Standalone Pharmacies

	(1)	(2)
Sample →	Standalone Pharmacies	Non-Standalone Pharmacies
1{Year ≥ 2004} × **1**{High Share 65+ in 2000}	-0.077***	-0.040***
	(0.013)	(0.012)
Psuedo-R^2	0.877	0.877
Observations	29,340	29,340

Source: National Establishment Time-Series, 2000-2009.
Note: The estimates are obtained via the Poisson specification shown in equation (1). The dependent variable is the number of pharmacies in a county. The independent variable of interest is an indicator for the passage of Medicare Part D interacted with an indicator for whether the county had an above-median share of elderly adults in the year 2000. All columns include county and year fixed effects, county-level demographic and economic controls, and state-by-year fixed effects. Column 1 explores changes among standalone (i.e., non-chain) pharmacies, while column 2 explores changes among non-standalone pharmacies. Because they are estimated via a Poisson specification, the results are interpreted as changes in natural log of the dependent variable. Standard errors, shown in parentheses, are clustered at the county level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 5: Medicare Part D was Associated with a Reduction in the Number of Pharmacy Openings

	(1)	(2)
Outcome →	Openings	Closures
1{Year ≥ 2004} ×	-0.088**	0.010
1{High Share 65+ in 2000}	(0.037)	(0.041)
Psuedo-R^2	0.718	0.581
Observations	29,340	29,340

Source: National Establishment Time-Series, 2000-2009.
Note: The estimates are obtained via the Poisson specification shown in equation (1). The dependent variable in column 1 is the number of pharmacy openings in a county, and the dependent variable in column 2 is the number of pharmacy closures in a county. The independent variable of interest is an indicator for the passage of Medicare Part D interacted with an indicator for whether the county had an above-median share of elderly adults in the year 2000. All columns include county and year fixed effects, county-level demographic and economic controls, and state-by-year fixed effects. Because they are estimated via a Poisson specification, the results are interpreted as changes in natural log of the dependent variable. Standard errors, shown in parentheses, are clustered at the county level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 6: Medicare Part D was Associated with a Reduction in the Number of Nearby Pharmacies

	(1)	(2)	(3)
Distance →	Low-Competition Area	Medium-Competition Area	High-Competition Area
Panel A: Nearby is 1 Kilometer			
1{Year ≥ 2004} ×	-0.049	-0.051***	-0.063***
1{High Share 65+ in 2000}	(0.094)	(0.015)	(0.017)
R^2	0.230	0.107	0.568
Observations	178,716	175,244	79,090
Panel B: Nearby is 5 Kilometers			
1{Year ≥ 2004} ×	-0.088***	-0.043***	-0.068**
1{High Share 65+ in 2000}	(0.014)	(0.011)	(0.027)
R^2	0.224	0.282	0.895
Observations	135,901	195,811	101,338
Panel C: Nearby is 10 Kilometers			
1{Year ≥ 2004} ×	-0.069***	-0.047***	-0.046*
1{High Share 65+ in 2000}	(0.014)	(0.012)	(0.027)
R^2	0.285	0.579	0.952
Observations	120,692	205,589	106,769

Source: National Establishment Time-Series, 2000-2009.

Note: The estimates are obtained from estimating equation (3). The dependent variable is the number of competitors within 1 kilometer (Panel A), 5 kilometers (Panel B), and 10 kilometers (Panel C). Column 1 limits the sample to counties that were in the bottom quartile of the competition distribution in 2003, column 2 limits the sample to counties that were in the middle two quartiles of the competition distribution in 2003, and column 3 limits the sample to counties in the top quartile of the competition in 2003. The independent variable of interest is an indicator for the passage of Medicare Part D interacted with an indicator for whether the county had an above-median share of elderly adults in the year 2000. All columns include establishment and year fixed effects, county-level demographic and economic controls, and state-by-year fixed effects. Standard errors, shown in parentheses, are clustered at the county level.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 7: Medicare Part D was Unrelated to Changes in Sales Conditional on Being Open

	(1)	(2)
Outcome →	ln(Sales)	ln(Number of Employees)
Panel A: County-Level Analysis		
1{Year ≥ 2004} ×	-0.045***	-0.024*
1{High Share 65+ in 2000}	(0.014)	(0.012)
R^2	0.978	0.979
Observations	29,340	29,340
Panel B: Establishment-Level Analysis (i.e., Conditional on Being Open)		
1{Year ≥ 2004} ×	0.003	0.003
1{High Share 65+ in 2000}	(0.005)	(0.004)
R^2	0.943	0.947
Observations	527,401	527,401

Source: National Establishment Time-Series, 2000-2009.

Note: The estimates are obtained from equation (3) estimated via ordinary least squares. The dependent variable in column 1 is the natural log of pharmacy sales, while the dependent variable in column 2 is the natural log of the number of pharmacy employees. The independent variable of interest is an indicator for the passage of Medicare Part D interacted with an indicator for whether the county had an above-median share of elderly adults in the year 2000. Panel A examines all pharmacies, Panel B limits the sample to standalone (i.e., non-chain) pharmacies, and Panel C limits the sample to non-standalone pharmacies. All columns include establishment and year fixed effects, county-level demographic and economic controls, and state-by-year fixed effects. Standard errors, shown in parentheses, are clustered at the county level.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 8: Suggestive Evidence That Medicare Part D Was Associated with a Smaller Mortality Reduction in Counties Experiencing a Reduction in the Number of Pharmacies

	(1)	(2)	(3)	(4)
Sample →	All Counties	Counties with a Low Share 65+ in 2000	Counties with a High Share 65+ in 2000	All Counties
1{Year ≥ 2004} × **1**{Age = 66}	-0.018***	-0.020***	-0.009	
	(0.005)	(0.006)	(0.010)	
1{Year ≥ 2004} × **1**{Age = 66} × **1**{High Share 65+ in 2000}				0.016
				(0.011)
Pseudo-R^2	0.844	0.865	0.745	0.859
Observations	58,660	29,520	29,140	58,660
County & Year FE?	Y	Y	Y	Y
County Demographics?	Y	Y	Y	Y
County Unemployment Rate?	Y	Y	Y	Y
State-by-Year FE?	Y	Y	Y	Y
Age-by-Year FE?				Y
County-by-Age FE?				Y
County-by-Year FE?				Y

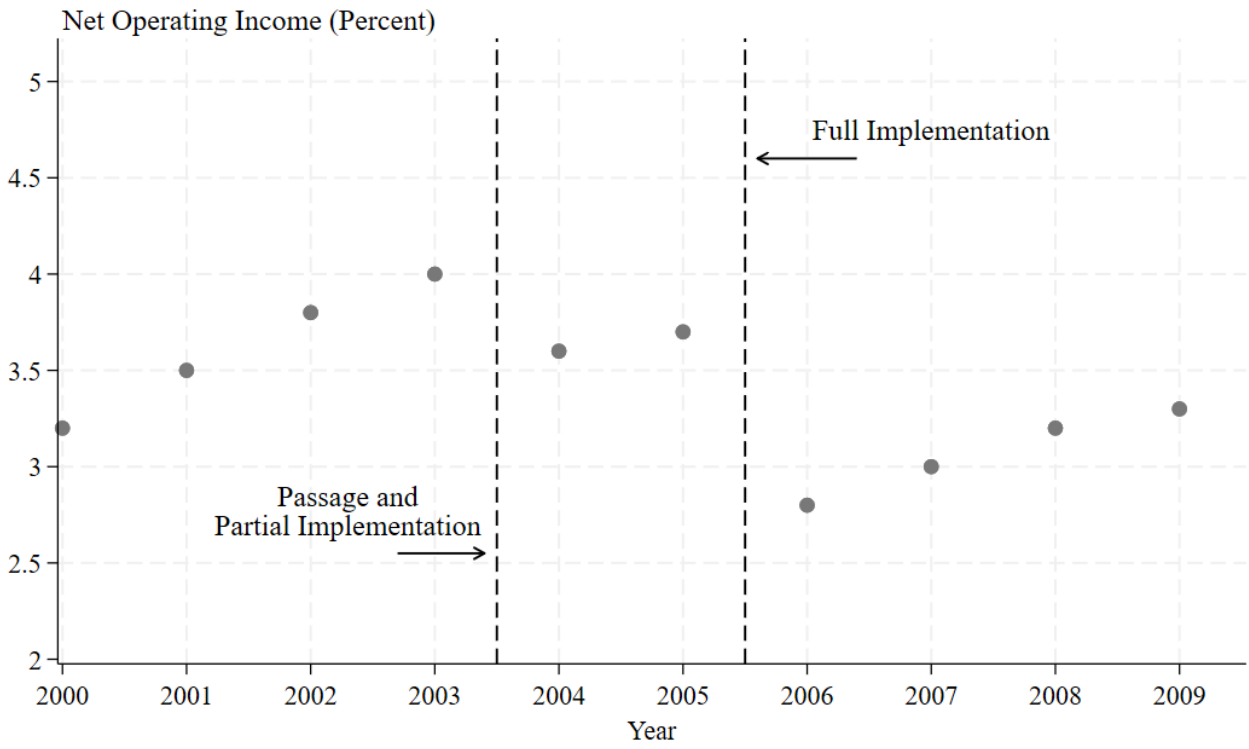
Source: Vital Statistics Mortality Files, 2000-2009.

Note: The dependent variable is the number of county-level deaths in a given year. The independent variable of interest is an indicator for the passage of Medicare Part D interacted with an indicator for being aged 66. The estimates are obtained from equation (4) comparing changes for those aged 66 to the changes for those aged 64. All columns include county fixed effects, county-level demographic and economic controls, and state-by-year fixed effects. Column 1 examines all counties, column 2 examines counties that had an above-median share of the population comprised of adults aged 65 or older in the year 2000, and column 3 examines counties that had a below-median share of the population comprised of elderly adults in the year 2000. Column 4 examines all counties but modifies equation (5) by interacting the independent variable of interest with an indicator for whether the county had a above-median share of the population comprise of elderly adults in the year 2000. This column includes age-by-year, county-by-age, and county-by-year fixed effects. Because they are estimated via a Poisson specification, the results are interpreted as changes in natural log of the dependent variable. Standard errors, shown in parentheses, are clustered at the county level.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

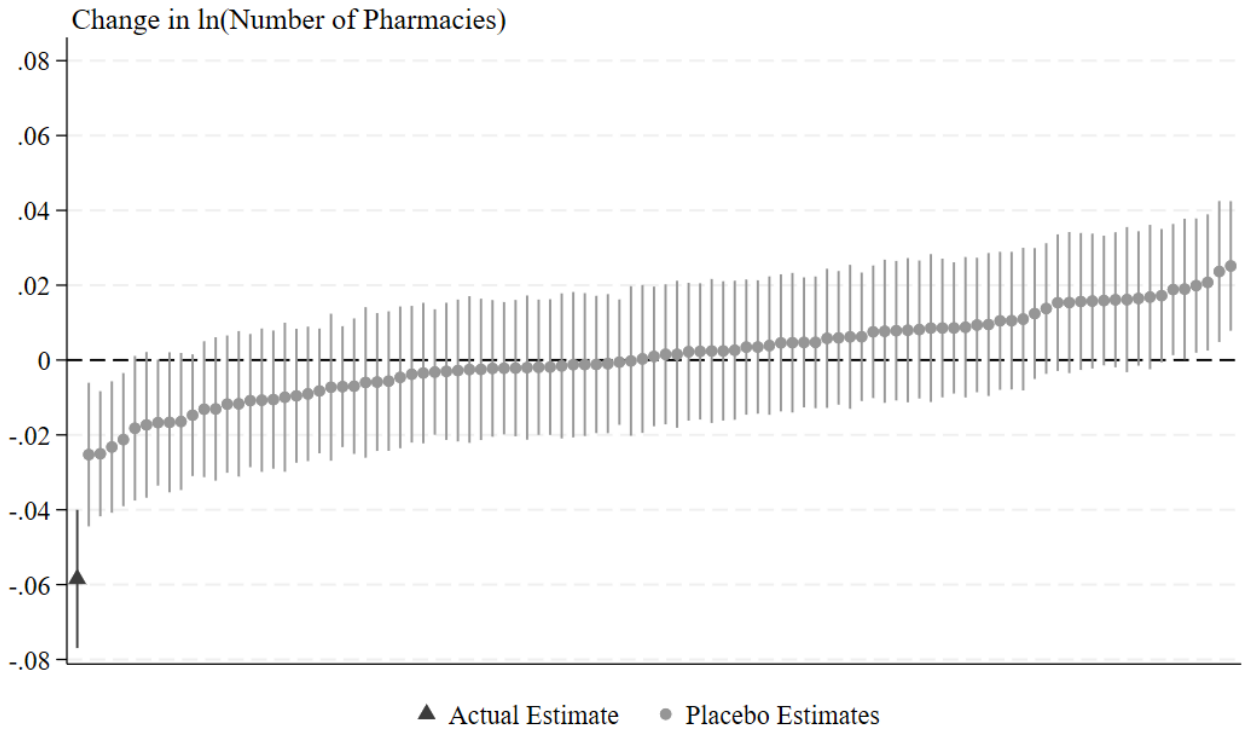
7. Appendix

Appendix Figure 1: Community Pharmacy Net Operating Income Over Time



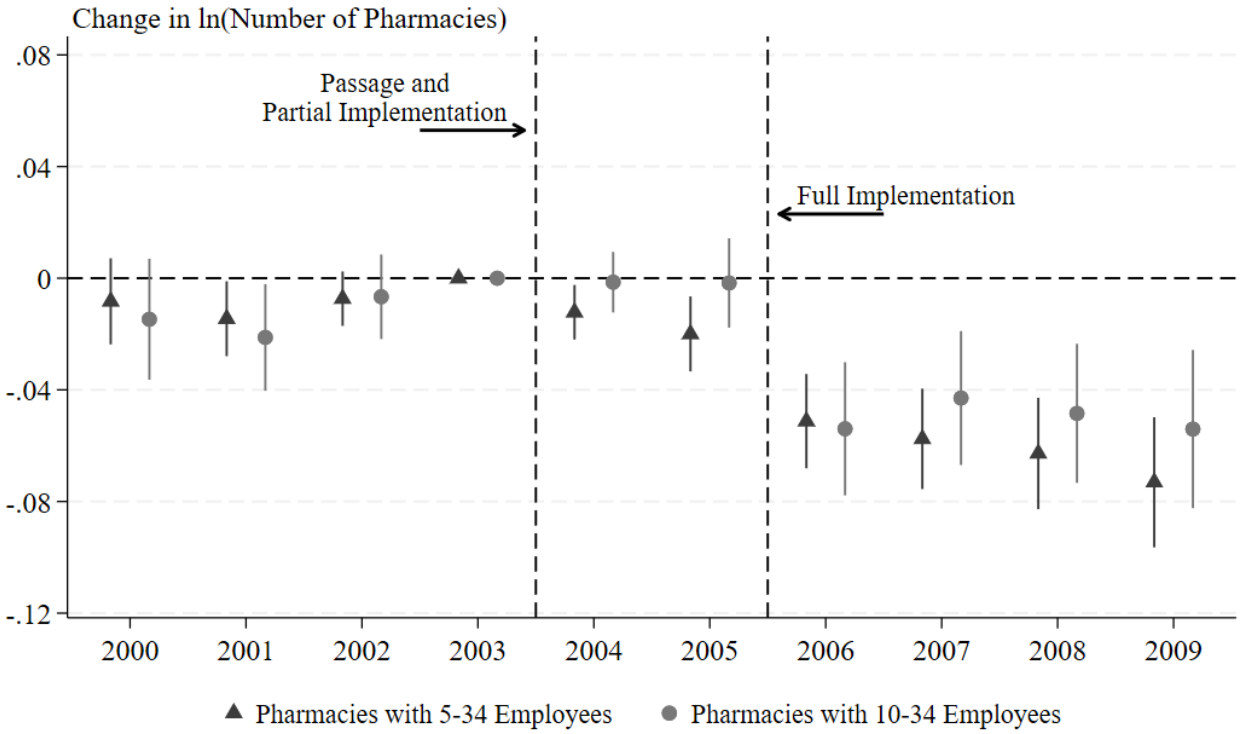
Source: National Community Pharmacy Association Digest 2000-2009.

Appendix Figure 2: Comparison of the Actual Result to 100 Placebo Estimates



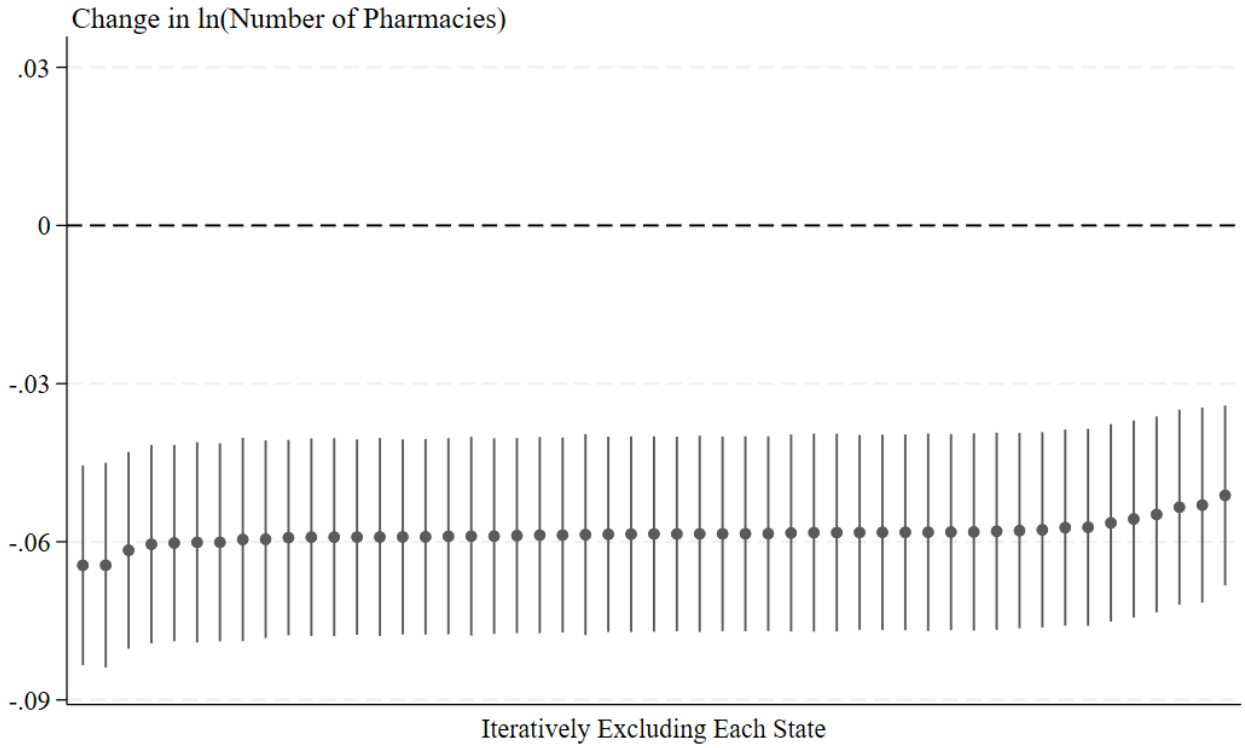
Source: National Establishment Time-Series, 2000-2009.
Note: The dependent variable is the number of pharmacies in a county. The independent variable of interest captures how the number of pharmacies changed following the passage of Medicare Part D in counties with an above-median share of the population comprised of elderly adults in the year 2000 relative to counties with a below-median share. The regressions include the full set of controls from equation (1). Because they are estimated via a Poisson specification, the results are interpreted as changes in natural log of the dependent variable. The light grey circles denote the placebo coefficients obtained from 100 iterations randomly matching each county to a county population share in the year 2000, while the vertical lines denote the corresponding 95 percent confidence interval. The dark grey triangle indicates the estimate obtained when matching counties to their actual population shares.

Appendix Figure 3: The Relationship Between Medicare Part D and the Number of Pharmacies is Robust to Excluding the Smallest and Largest Establishments



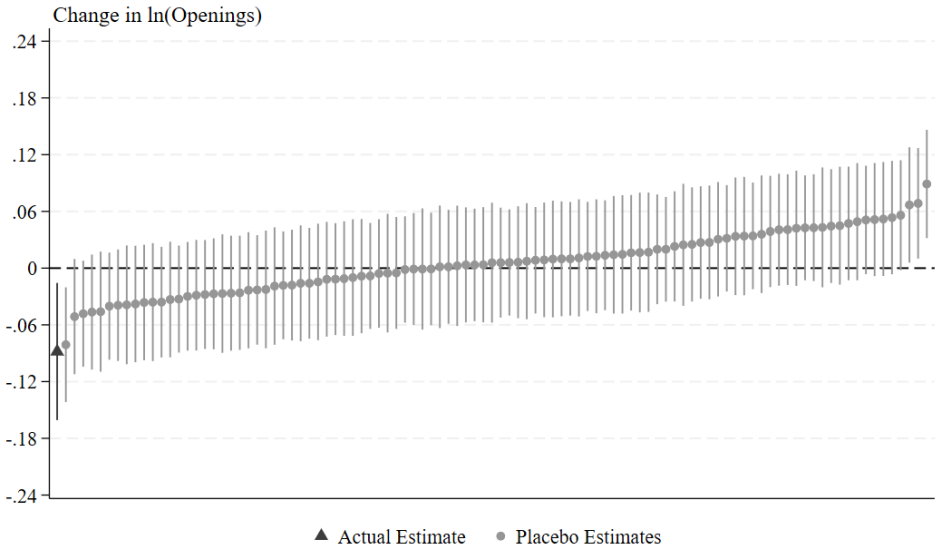
Source: National Establishment Time-Series, 2000-2009.
Note: The dependent variable is the number of pharmacies in a county. The markers indicate the coefficients and the vertical lines the 95 percent confidence intervals obtained from the event study specification shown in equation (2) comparing counties that had an above-median share of the population comprised of elderly adults in the year 2000 to counties that had a below-median share. The regression is estimated using a Poisson specification, so the results are interpreted as changes in natural log of the dependent variable. The dark grey triangles denote results where the sample is limited to pharmacies with 5-34 employees, while the light grey circles denote results where the sample is limited to pharmacies with 10-34 employees. Standard errors are clustered at the county level.

Appendix Figure 4: The Relationship Between Medicare Part D and the Number of Pharmacies is Robust to Iteratively Excluding Observations from Each State

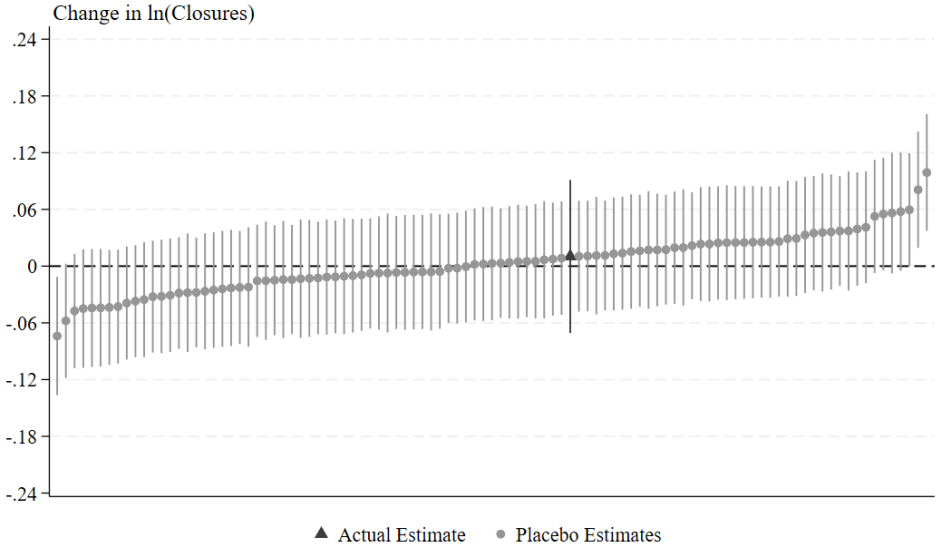


Source: National Establishment Time-Series, 2000-2009.
Note: The dependent variable is the number of pharmacies in a county. The independent variable of interest captures how the number of pharmacies changed following the passage of Medicare Part D in counties with an above-median share of the population comprised of elderly adults in the year 2000 relative to counties with a below-median share. The regressions include the full set of controls from equation (1). Because they are estimated via a Poisson specification, the results are interpreted as changes in natural log of the dependent variable. The grey circles denote the point estimates and the vertical lines the corresponding 95 percent confidence interval. The figure plots the distribution estimates obtained from iteratively excluding observations from each state that are ordered from smallest to largest (in absolute magnitude). Standard errors are clustered at the county level.

Appendix Figure 5: Comparisons of the Actual Relationship Between Medicare Part D and Changes in Pharmacy Openings and Closings to 100 Placebo Estimates



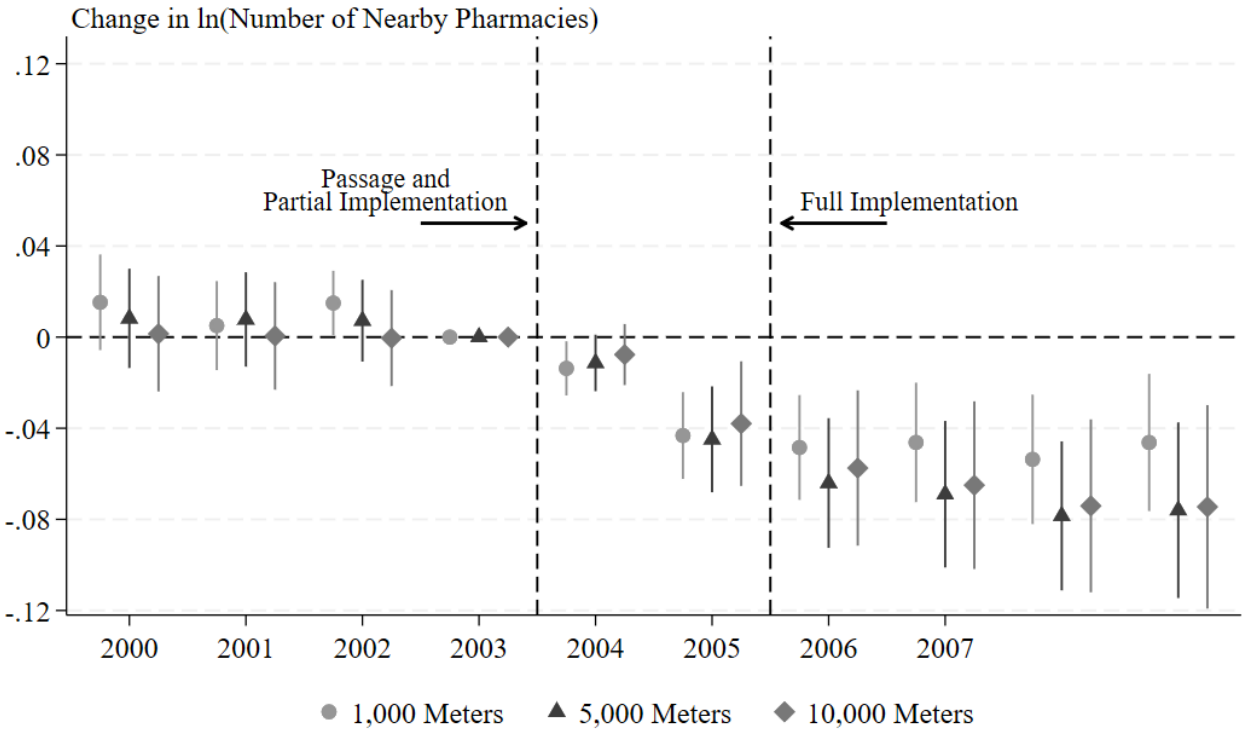
(A)



(B)

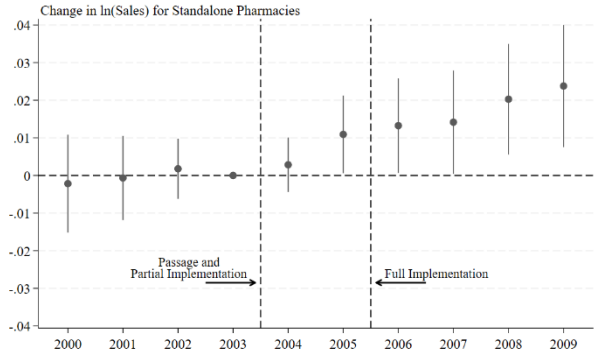
Source: National Establishment Time-Series, 2000-2009.
Note: The dependent variable in Panel A is the number of pharmacy openings in a county, and the dependent variable in Panel B is the number of pharmacy closures in a county. The independent variable of interest captures how the number of pharmacies changed following the passage of Medicare Part D in counties with an above-median share of the population comprised of elderly adults in the year 2000 relative to counties with a below-median share. The regressions include the full set of controls from equation (1). Because they are estimated via a Poisson specification, the results are interpreted as changes in natural log of the dependent variable. The light grey circles denote the placebo coefficients obtained from 100 iterations randomly matching each county to a county population share in the year 2000, while the vertical lines denote the corresponding 95 percent confidence interval. The dark grey triangle indicates the estimate obtained when matching counties to their actual population shares.

Appendix Figure 6: Medicare Part D was Associated with Reductions in Competition in the Post-Period

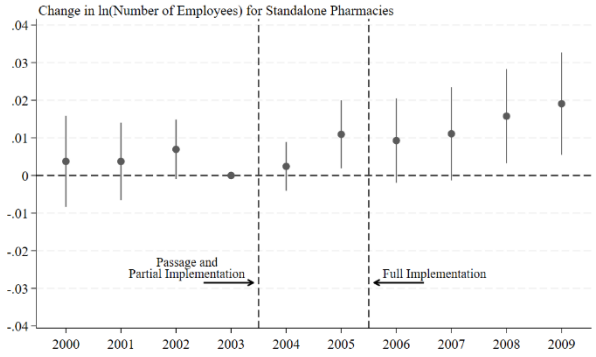


Source: National Establishment Time-Series, 2000-2009.
Note: The dependent variable is the number of nearby pharmacies. The light grey circles indicate results where nearby is defined as a 1,000-meter radius, the dark grey triangles indicate results where nearby is defined as a 5,000-meter radius, and the grey diamonds indicate results where nearby is fined as a 10,000-meter radius. The vertical lines denote the corresponding 95 percent confidence intervals. The estimates are obtained using the event study specification shown in equation (4) comparing pharmacies in counties that had a above-median share of the population comprised of elderly adults in the year 2000 to pharmacies in counties that had a below-median share. The sample is limited to standalone pharmacies. To ensure that the results are not driven by composition changes, the sample is limited to pharmacies that remained open in all years between 2000 and 2009. Standard errors are clustered at the county level.

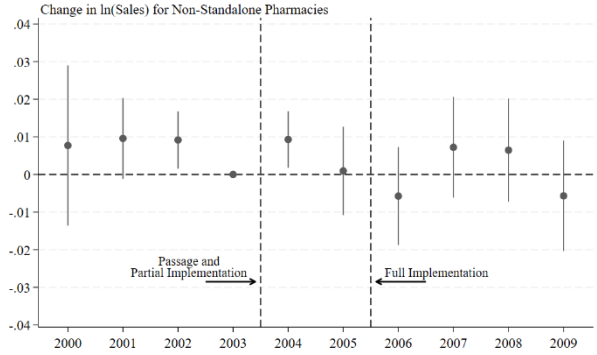
Appendix Figure 7: Medicare Part D was Associated with Increases in Sales and Employment Among Standalone Pharmacies Conditional on Being Open



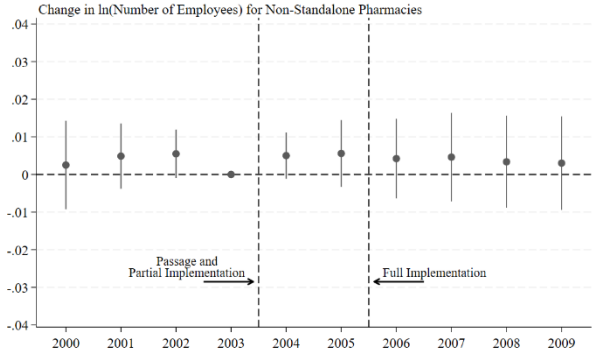
(A) Standalone Pharmacy Sales



(B) Standalone Pharmacy Employment



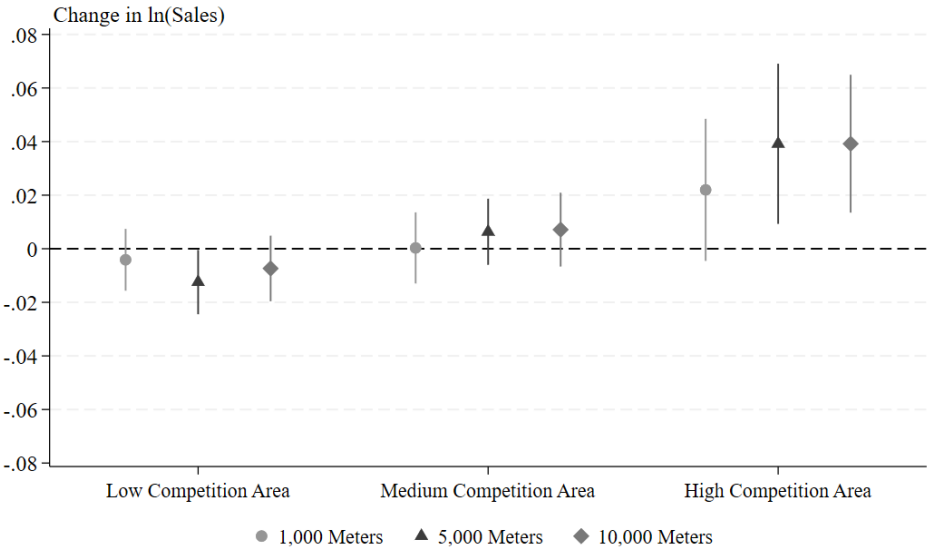
(C) Non-Standalone Pharmacy Sales



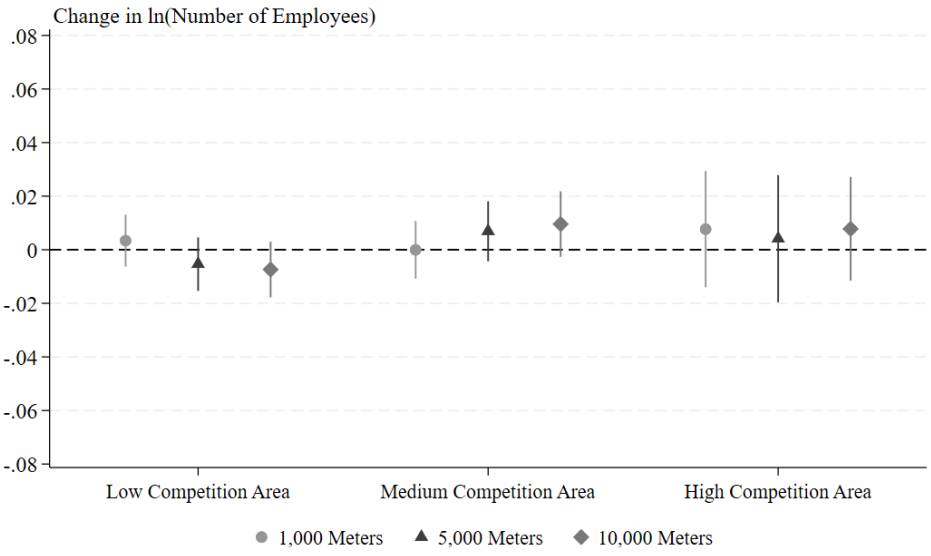
(D) Non-Standalone Pharmacy Employment

Source: National Establishment Time-Series, 2000-2009.
Note: The dependent variable in Panels A and C is the natural log of the pharmacy's sales. The dependent variable in Panels B and D is the natural log of the number of employees. The grey circles indicate the coefficients and the vertical lines the 95 percent confidence intervals obtained from the event study specification shown in equation (2) comparing pharmacies in counties that had an above-median share of the population comprised of elderly adults in the year 2000 to pharmacies in counties that had a below-median share. The sample in Panels A and B is limited to standalone pharmacies. The sample in Panels C and D is limited to non-standalone pharmacies. To ensure that the results are not driven by composition changes, the sample is limited to pharmacies that remained open in all years between 2000 and 2009. Standard errors are clustered at the county level.

Appendix Figure 8: The Relationship Between Medicare Part D and Pharmacy Sales, by Nearby Sales Volume Prior to Medicare Part D's Passage



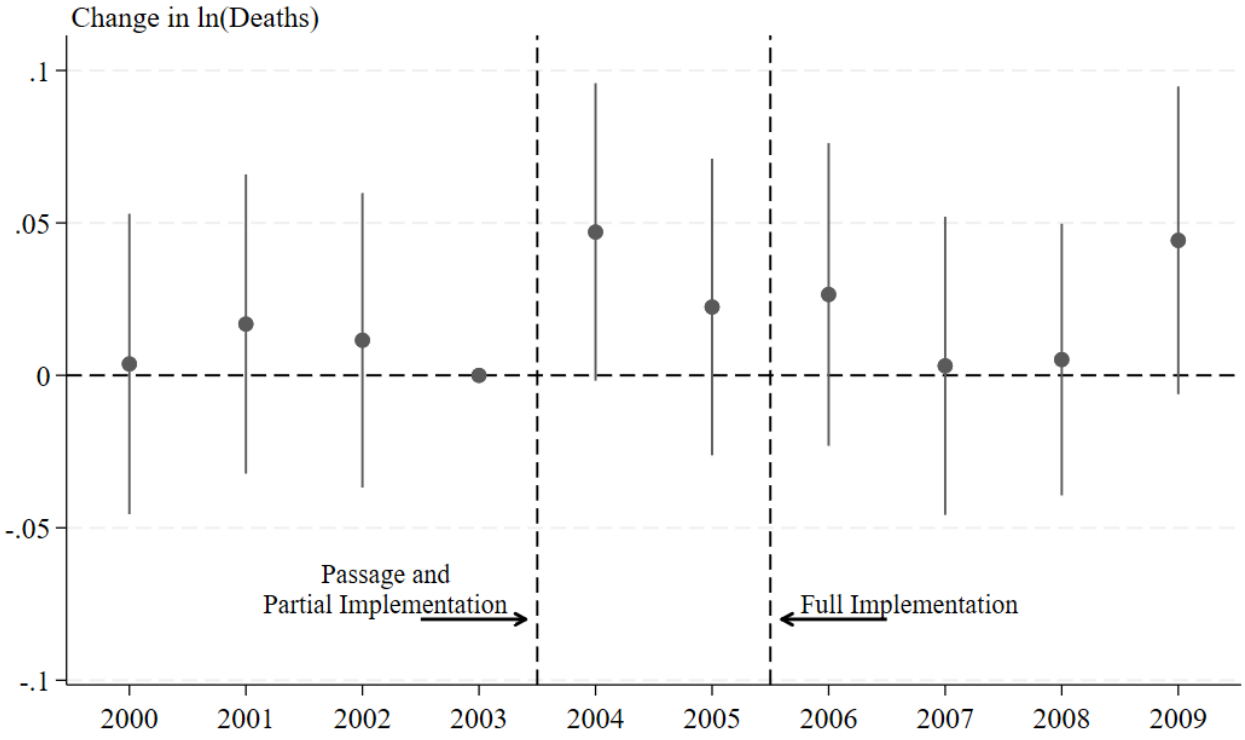
(A)



(B)

Source: National Establishment Time-Series, 2000-2009.
Note: The dependent variable in Panel A is the natural log of sales, and the dependent variable in Panel B is the natural log of the number of employees. The independent variable of interest captures how the number of pharmacies changed following the passage of Medicare Part D in counties with an above-median share of the population comprised of elderly adults in the year 2000 relative to counties with a below-median share. The regressions include the full set of controls from equation (3). Each estimate is from a separate regression where the sample is limited to establishments in low, medium, or high competition areas in the year 2003 based on the total sales volume from nearby pharmacies. The light grey circles denote results where we define a competition area using a 1,000-meter radius, the dark grey triangles denote results where we define a competition area using a 5,000-meter radius, and the grey diamonds denote results where we define a competition area using a 10,000-meter radius. Standard errors are clustered at the county level.

Appendix Figure 9: Triple-Difference Event Study Estimates Comparing Changes in Mortality Around the Passage of Medicare Part D for 66-Year-Olds to 64-Year-Olds Based on Whether the County Had an Above-Median Share of the Population Comprised of Elderly Adults in the Year 2000



Source: Vital Statistics Mortality Files, 2000-2009.

Note: The dependent variable is the number of county-level deaths in a given year. The estimates are obtained from a modified version of equation (5) where the independent variables of interest indicate the years around the passage of Medicare Part D, that a county had an above-median share of the population comprised of elderly adults in the year 2000, and that the deaths were for 66-year-olds instead of 64-year-olds. The grey circles denote the point estimates, and the vertical lines denote the corresponding 95 percent confidence intervals. In addition to county-level demographic controls, the specification includes age-by-year, county-by-age, and county-by-year fixed effects. Because they are estimated via a Poisson specification, the results are interpreted as changes in natural log of the dependent variable. Standard errors are clustered at the county level.

Appendix Table 1: Summary Statistics of Control Variables for NETS Regressions

	(1)	(2)	(3)
Sample →	Overall	Below-Median Share	Above-Median Share
Panel A: County-Level			
ln(Population)	10.39	10.94	9.83
	(1.33)	(1.30)	(1.12)
Share Black	0.093	0.127	0.059
	(0.146)	(0.166)	(0.113)
Share Hispanic	0.071	0.091	0.050
	(0.124)	(0.149)	(0.113)
Unemployment Rate	5.75	5.86	5.64
	(2.36)	(2.45)	(2.25)
Observations	29,340	14,770	14,570
Panel B: Establishment-Level			
ln(Population)	12.68	13.06	11.61
	(1.70)	(1.55)	(1.66)
Share Black	0.137	0.156	0.084
	(0.137)	(0.144)	(0.097)
Share Hispanic	0.137	0.163	0.061
	(0.158)	(0.171)	(0.072)
Unemployment Rate	5.73	5.76	5.63
	(2.20)	(2.22)	(2.11)
Observations	527,401	391,035	136,366

Source: National Establishment Time-Series, 2000-2009.

Note: The table reports the sample mean and standard deviations (in parentheses).

Appendix Table 2: Summary Statistics for Vital Statistics Mortality Data

	(1)	(2)	(3)
Sample →	Overall	Below-Median Share	Above-Median Share
Panel A: 66-Year-Old Deaths			
Overall	333,056	241,572	91,484
Male	192,374	138,873	53,501
Female	140,682	102,699	37,983
White	276,897	193,436	83,461
Non-White	56,159	48,136	8,023
Panel B: 64-Year-Old Deaths			
Overall	309,949	226,347	83,602
Male	181,373	131,543	49,830
Female	128,576	94,804	33,772
White	255,360	179,558	75,802
Non-White	54,589	46,789	7,800

Source: National Establishment Time-Series, 2000-2009.
Note: The table reports the sample mean and standard deviations (in parentheses).

Appendix Table 3: Event Study Estimates

	(1)	(2)	(3)
Outcome →	ln(Establishments)	ln(Openings)	ln(Closures)
Pre-Period			
1{Year = 2000} ×	0.009	-0.013	-0.002
1{Above-Median Share}	(0.009)	(0.081)	(0.077)
1{Year = 2001} ×	0.003	-0.088	0.058
1{Above-Median Share}	(0.008)	(0.074)	(0.079)
1{Year = 2002} ×	0.009	0.052	-0.135*
1{Above-Median Share}	(0.006)	(0.064)	(0.081)
Post-Period			
1{Year = 2004} ×	-0.011***	-0.123*	0.037
1{Above-Median Share}	(0.004)	(0.073)	(0.072)
1{Year = 2005} ×	-0.043***	-0.245***	0.063
1{Above-Median Share}	(0.006)	(0.063)	(0.078)
1{Year = 2006} ×	-0.059***	-0.128**	-0.091
1{Above-Median Share}	(0.008)	(0.053)	(0.081)
1{Year = 2007} ×	-0.061***	-0.030	-0.043
1{Above-Median Share}	(0.009)	(0.079)	(0.094)
1{Year = 2008} ×	-0.065***	-0.013	-0.005
1{Above-Median Share}	(0.010)	(0.069)	(0.086)
1{Year = 2009} ×	-0.077***	-0.019	-0.022
1{Above-Median Share}	(0.011)	(0.068)	(0.084)
Pre = 0?	F = 6.12	F = 2.62	F = 5.84
	p = 0.106	p = 0.453	p = 0.120
Post = 0?	F = 71.94	F = 28.46	F = 5.41
	p = 0.000	p = 0.000	p = 0.492
Pre = Post?	F = 76.87	F = 36.40	F = 10.50
	p = 0.000	p = 0.000	p = 0.312
Observations	29,340	29,340	29,340

Source: National Establishment Time-Series, 2000-2009.

Note: The dependent variable in column 1 is the number of pharmacies in a county, in column 2 the number of pharmacy openings, and in column 3 the number of pharmacy closures. The estimates are obtained from the event study specification shown in equation (2) comparing counties that had an above-median share of the population comprised of elderly adults in the year 2000 to counties that had a below-median share. The regression is estimated using a Poisson specification, so the results are interpreted as changes in natural log of the dependent variable. The F-tests for Pre = 0 evaluate whether pre-period coefficients are jointly zero, the tests for Post = 0 assess the joint significance of post-period effects, and Pre = Post evaluates for differences on average coefficient between pre and post period. Standard errors, shown in parentheses, are clustered at the county level.

*** p < 0.01, ** p < 0.05, * p < 0.10

Appendix Table 4: The Relationship Between Medicare Part D and the Number of Pharmacies is Robust to Alternative Ways of Specifying the Independent Variable

	(1)	(2)	(3)
1{Year ≥ 2004} × **1**{High Share 65+ in 2000}	-0.058*** (0.009)		
1{Year ≥ 2004} × **1**{Q2 Share 65+ in 2000}		-0.048*** (0.011)	
1{Year ≥ 2004} × **1**{Q3 Share 65+ in 2000}		-0.081*** (0.012)	
1{Year ≥ 2004} × **1**{Q4 Share 65+ in 2000}		-0.086*** (0.013)	
1{Year ≥ 2004} × Share 65+ in 2000			-1.018*** (0.135)
Psuedo-R^2	0.919	0.919	0.919
Observations	29,340	29,340	29,340

Source: National Establishment Time-Series, 2000-2009.

Note: The estimates are obtained via the Poisson specification shown in equation (1). The dependent variable in column 1 is the number of pharmacies in a county, the dependent variable in column 2 is the number of pharmacy openings in a county, and the dependent variable in column 3 is the number of pharmacy closures in a county. The independent variable of interest in column 1 is an indicator for the passage of Medicare Part D interacted with an indicator for whether the county had an above-median share of elderly adults in the year 2000. The independent variables of interest in column 2 are the interaction of the post-period indicator with indicators for whether the share of the county population comprised of elderly individuals in the year 2000 was in the 2nd, 3rd, or 4th quartile. The independent variable of interest in column 3 is the post-period indicator interacted with the share of the county population in the year 2000 comprised of elderly individuals. All columns include county and year fixed effects, county-level demographic and economic controls, and state-by-year fixed effects. Because they are estimated via a Poisson specification, the results are interpreted as changes in natural log of the dependent variable. Standard errors, shown in parentheses, are clustered at the county level.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Appendix Table 5: The Relationship Between Medicare Part D and the Number of Pharmacy Openings is Robust to Alternative Ways of Specifying the Independent Variable

	(1)	(2)	(3)	(4)	(5)	(6)
	Change in ln(Openings)			Change in ln(Closures)		
1{Year ≥ 2004} ×	-0.088**			0.010		
1{High Share 65+ in 2000}	(0.037)			(0.041)		
1{Year ≥ 2004} ×		-0.056			-0.073**	
1{Q2 Share 65+ in 2000}		(0.038)			(0.037)	
1{Year ≥ 2004} ×		-0.140***			-0.053	
1{Q3 Share 65+ in 2000}		(0.046)			(0.054)	
1{Year ≥ 2004} ×		-0.070			0.022	
1{Q4 Share 65+ in 2000}		(0.063)			(0.057)	
1{Year ≥ 2004} ×			-0.782			-0.127
Share 65+ in 2000			(0.519)			(0.484)
Psuedo-R^2	0.718	0.718	0.718	0.581	0.581	0.581
Observations	29,340	29,340	29,340	29,340	29,340	29,340

Source: National Establishment Time-Series, 2000-2009.

Note: The estimates are obtained via the Poisson specification shown in equation (1). The dependent variable in columns 1-3 is the number of pharmacy openings in a county, and the dependent variable in columns 4-6 is the number of pharmacy closures in a county. The independent variable of interest in column 1 is an indicator for the passage of Medicare Part D interacted with an indicator for whether the county had an above-median share of elderly adults in the year 2000. The independent variables of interest in column 2 are the interaction of the post-period indicator with indicators for whether the share of the county population comprised of elderly individuals in the year 2000 was in the 2nd, 3rd, or 4th quartile. The independent variable of interest in column 3 is the post-period indicator interacted with the share of the county population in the year 2000 comprised of elderly individuals. All columns include county and year fixed effects, county-level demographic and economic controls, and state-by-year fixed effects. Because they are estimated via a Poisson specification, the results are interpreted as changes in natural log of the dependent variable. Standard errors, shown in parentheses, are clustered at the county level.

*** p < 0.01, ** p < 0.05, * p < 0.10

Appendix Table 6: The Relationship Between Medicare Part D and the Number of Pharmacy Openings is Robust to Excluding the Smallest and Largest Establishments

	(1)	(2)	(3)	
Outcome →	Change in ln(Openings)		Change in ln(Closures)	
Sample →	Pharmacies with 5-34 Employees	Pharmacies with 10-34 Employees	Pharmacies with 5-34 Employees	Pharmacies with 10-34 Employees
1{Year ≥ 2004} × **1**{High Share 65+ in 2000}	-0.161**	-0.109	0.001	0.046
	(0.064)	(0.087)	(0.048)	(0.066)
Psuedo-R^2	0.551	0.541	0.467	0.431
Observations	29,340	29,340	29,340	29,340

Source: National Establishment Time-Series, 2000-2009.

Note: The estimates are obtained via the Poisson specification shown in equation (1). The dependent variable in columns 1 and 2 is the number of pharmacy openings in a county, and the dependent variable in columns 3 and 4 is the number of pharmacy closures in a county. The independent variable of interest is an indicator for the passage of Medicare Part D interacted with an indicator for whether the county had an above-median share of elderly adults in the year 2000. All columns include county and year fixed effects, county-level demographic and economic controls, and state-by-year fixed effects. Columns 1 and 3 only consider establishments with 5-34 employees, while columns 2 and 4 only consider establishments with 10-24 employees. Because they are estimated via a Poisson specification, the results are interpreted as changes in natural log of the dependent variable. Standard errors, shown in parentheses, are clustered at the county level.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Appendix Table 7: Medicare Part D was Associated with a Reduction in Both Standalone and Non-Standalone Openings

	(1)	(2)
Sample →	Standalone Pharmacies	Non-Standalone Pharmacies
Panel A: Change in ln(Openings)		
1{Year ≥ 2004} ×	-0.111**	-0.041
1{High Share 65+ in 2000}	(0.046)	(0.060)
Psuedo-R^2	0.680	0.590
Observations	29,340	29,340
Panel B: Change in ln(Closures)		
1{Year ≥ 2004} ×	-0.115*	0.135**
1{High Share 65+ in 2000}	(0.065)	(0.060)
Psuedo-R^2	0.510	0.477
Observations	29,340	29,340

Source: National Establishment Time-Series, 2000-2009.
Note: The estimates are obtained via the Poisson specification shown in equation (1). The dependent variable in Panel A is the number of pharmacy openings in a county, and the dependent variable in Panel B is the number of pharmacy closures in a county. The independent variable of interest is an indicator for the passage of Medicare Part D interacted with an indicator for whether the county had an above-median share of elderly adults in the year 2000. All columns include county and year fixed effects, county-level demographic and economic controls, and state-by-year fixed effects. Column 1 explores changes among standalone (i.e., non-chain) pharmacies, while column 2 explores changes among non-standalone pharmacies. Because they are estimated via a Poisson specification, the results are interpreted as changes in natural log of the dependent variable. Standard errors, shown in parentheses, are clustered at the county level.
*** p < 0.01, ** p < 0.05, * p < 0.10

Appendix Table 8: Summary Statistics of the Competition Measures

	(1)	(2)	(3)
Sample →	Overall	Below-Median Share	Above-Median Share
Pharmacies w/in 1 km	1.94	2.16	1.31
	(4.13)	(4.31)	(3.47)
Pharmacies w/in 5 km	18.94	22.72	8.09
	(39.79)	(45.10)	(11.51)
Pharmacies w/in 10 km	55.85	67.51	22.39
	(115.95)	(130.64)	(36.30)
Pharmacies per 100K w/in 1 km	1.13	0.76	2.17
	(3.70)	(2.28)	(6.05)
Pharmacies per 100K w/in 5 km	4.64	3.95	6.63
	(8.04)	(6.29)	(11.46)
Pharmacies per 100K w/in 10 km	9.27	8.76	10.76
	(16.77)	(14.12)	(22.65)
Observations	527,401	391,035	136,366

Source: National Establishment Time-Series, 2000-2009.
Note: The table reports the sample mean and standard deviations (in parentheses).

Appendix Table 9: Medicare Part D and Changes in Sales and Employment for Standalone and Non-Standalone Pharmacies

	(1)	(2)	(3)	(4)
Outcome →	ln(Sales)		ln(Number of Employees)	
Sample →	Standalone Pharmacies	Non-Standalone Pharmacies	Standalone Pharmacies	Non-Standalone Pharmacies
Panel A: County-Level Analysis – OLS with ln(Outcome + 1)				
1{Year ≥ 2004} ×	-0.081	-0.105	-0.044***	-0.024
1{High Share 65+ in 2000}	(0.061)	(0.103)	(0.015)	(0.021)
R^2	0.855	0.942	0.956	0.972
Observations	29,340	29,340	29,340	29,340
Panel B: County-Level Analysis – Poisson Regression				
1{Year ≥ 2004} ×	-0.088***	-0.012	-0.070**	-0.024
1{High Share 65+ in 2000}	(0.032)	(0.031)	(0.032)	(0.029)
R^2	0.981	0.987	0.955	0.979
Observations	29,340	29,340	29,340	29,340
Panel C: Establishment-Level Analysis (i.e., Conditional on Being Open) – OLS with ln(Outcome)				
1{Year ≥ 2004} ×	0.014**	-0.002	0.004	0.004
1{High Share 65+ in 2000}	(0.006)	(0.006)	(0.005)	(0.005)
R^2	0.956	0.925	0.917	0.927
Observations	285,752	241,649	285,752	241,649
Panel D: Establishment-Level Analysis (i.e., Conditional on Being Open) -- Poisson Regression				
1{Year ≥ 2004} ×	-0.005	0.020	0.018	-0.004
Share 65+ in 2000	(0.019)	(0.019)	(0.019)	(0.017)
R^2	0.928	0.945	0.667	0.818
Observations	285,752	241,649	285,752	241,649

Source: National Establishment Time-Series, 2000-2009.

Note: The estimates in Panels A and B are estimated using the specification shown in equation (1). Panel A is estimated via ordinary least squares, and Panel B is estimated via Poisson regression. To account for the fact that not all counties have non-zero values for the outcomes, the dependent variables in Panel A are the natural log of the outcome plus 1. The estimates in Panels C and D are estimated using the specification shown in equation (3). Panel C is estimated via ordinary least squares, and Panel D is estimated via Poisson regression. The independent variable of interest is an indicator for the passage of Medicare Part D interacted with an indicator for whether the county had an above-median share of elderly adults in the year 2000. The dependent variable in columns 1 and 2 is the natural log of pharmacy sales, while the dependent variable in columns 3 and 4 is the natural log of the number of pharmacy employees. Columns 1 and 3 examine changes for standalone pharmacies, while columns 2 and 4 examine changes for non-standalone pharmacies.

Standard errors, shown in parentheses, are clustered at the county level.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Appendix Table 10: Medicare Part D and Changes in Pharmacy Sales and Employment, Alternative Ways of Specifying the Independent Variable

	(1)	(2)	(3)	(4)
Outcome →	ln(Sales)		ln(Number of Employees)	
Sample →	Standalone Pharmacies	Non-Standalone Pharmacies	Standalone Pharmacies	Non-Standalone Pharmacies
Panel A: Elderly Quartile				
1{Year ≥ 2004} ×	0.023***	0.006	0.009*	0.006
1{Q2 Share 65+ in 2000}	(0.007)	(0.007)	(0.005)	(0.006)
1{Year ≥ 2004} ×	0.023***	0.005	0.009	0.008
1{Q3 Share 65+ in 2000}	(0.009)	(0.008)	(0.007)	(0.007)
1{Year ≥ 2004} ×	0.029***	-0.006	0.008	0.005
1{Q4 Share 65+ in 2000}	(0.009)	(0.011)	(0.007)	(0.009)
R^2	0.928	0.925	0.917	0.927
Observations	285,752	241,649	285,752	241,649
Panel B: Continuous Share				
1{Year ≥ 2004} ×	0.302***	0.057	0.101	0.105
Share 65+ in 2000	(0.085)	(0.088)	(0.068)	(0.074)
R^2	0.928	0.925	0.925	0.935
Observations	285,752	241,649	285,752	241,649

Source: National Establishment Time-Series, 2000-2009.

Note: The estimates are obtained via the ordinary least squares specification shown in equation (3). The dependent variable in columns 1 and 2 is the natural log of pharmacy sales, while the dependent variable in columns 3 and 4 is the natural log of the number of pharmacy employees. The independent variables of interest in Panel A are the interaction of the post-period indicator with indicators for whether the share of the county population comprised of elderly individuals in the year 2000 was in the 2nd, 3rd, or 4th quartile. The independent variable of interest in Panel B is the post-period indicator interacted with the share of the county population in the year 2000 comprised of elderly individuals. Columns 1 and 3 limit the sample to standalone pharmacies, while columns 2 and 4 limit the sample to non-standalone pharmacies. All columns include establishment and year fixed effects, county-level demographic and economic controls, and state-by-year fixed effects. Standard errors, shown in parentheses, are clustered at the county level.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Appendix Table 11: The Relationships Between Medicare Part D, Pharmacy Sales, and Pharmacy Employees, Excluding the Smallest and Largest Establishments

	(1)	(2)	(3)	(4)
Outcome →	Change in ln(Sales)		Change in ln(Employees)	
Sample →	Pharmacies with 5-34 Employees	Pharmacies with 10-34 Employees	Pharmacies with 5-34 Employees	Pharmacies with 10-34 Employees
Panel A: All Pharmacies				
1{Year ≥ 2004} ×	-0.000	-0.001	0.007**	0.001
1{High Share 65+ in 2000}	(0.004)	(0.004)	(0.003)	(0.002)
R^2	0.954	0.937	0.962	0.950
Observations	330,976	189,908	330,976	189,908
Panel B: Standalone Pharmacies				
1{Year ≥ 2004} ×	0.009	0.013	0.005	-0.001
1{High Share 65+ in 2000}	(0.006)	(0.009)	(0.004)	(0.005)
R^2	0.948	0.956	0.943	0.941
Observations	148,011	44,598	148,011	44,598
Panel C: Non-Standalone Pharmacies				
1{Year ≥ 2004} ×	-0.001	-0.005	0.004	-0.001
1{High Share 65+ in 2000}	(0.004)	(0.004)	(0.003)	(0.003)
R^2	0.941	0.920	0.956	0.951
Observations	182,965	145,310	182,965	145,310

Source: National Establishment Time-Series, 2000-2009.

Note: The estimates are obtained via the ordinary least squares specification shown in equation (3). The dependent variable in columns 1 and 2 is the natural log of pharmacy sales, and the dependent variable in columns 3 and 4 is the natural log of the number of pharmacy employees. The independent variable of interest is an indicator for the passage of Medicare Part D interacted with an indicator for whether the county had an above-median share of elderly adults in the year 2000. All columns include county and year fixed effects, county-level demographic and economic controls, and state-by-year fixed effects. Columns 1 and 3 only consider establishments with 5-34 employees, while columns 2 and 4 only consider establishments with 10-34 employees. Panel A examines all pharmacies, Panel B examines standalone (i.e., non-chain) pharmacies, and Panel C examines non-standalone pharmacies. Standard errors, shown in parentheses, are clustered at the county level.

*** p < 0.01, ** p < 0.05, * p < 0.10

Appendix Table 12: Medicare Part D was Associated with a Reduction in the Number of Establishments Competing with Surviving Pharmacies

	(1)	(2)	(3)
Distance →	1,000 Meters	5,000 Meters	10,000 Meters
1{Year ≥ 2004} ×	-0.123**	-0.097***	-0.047*
1{High Share 65+ in 2000}	(0.051)	(0.028)	(0.026)
R^2	0.900	0.946	0.956
Observations	405,032	405,032	405,032

Source: National Establishment Time-Series, 2000-2007.
Note: The estimates are obtained from estimating equation (3) using ordinary least squares. The dependent variable is the natural log of the real value of total sales at nearby pharmacies + 1. Column 1 defines "nearby" as being within 1,000 meters, column 2 defines "nearby" as being within 5,000 meters, and column 3 defines "nearby" as being within 10,000 meters. The independent variable of interest is an indicator for the passage of Medicare Part D interacted with an indicator for whether the county had an above-median share of elderly adults in the year 2000. All columns include establishment and year fixed effects, county-level demographic and economic controls, and state-by-year fixed effects. Because they are estimated via a Poisson specification, the results are interpreted as changes in natural log of the dependent variable. Standard errors, shown in parentheses, are clustered at the county level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Appendix Table 13: Medicare Part D and Mortality for Adults Aged 66 Compared to Adults Aged 64, by Demographic Characteristics

	(1)	(2)	(3)	(4)
Outcome →	Male	Female	White	Non-White
Panel A: All Counties				
1{Year ≥ 2004} × **1**{Age = 66}	-0.023***	-0.017**	-0.020***	-0.017
	(0.007)	(0.008)	(0.005)	(0.015)
Pseudo-R^2	0.781	0.752	0.808	0.808
Observations	58,660	58,660	58,660	58,660
Panel B: Counties with a High Share 65+ in the Year 2000				
1{Year ≥ 2004} × **1**{Age = 66}	-0.020	0.000	-0.013	0.025
	(0.013)	(0.015)	(0.010)	(0.033)
Pseudo-R^2	0.667	0.624	0.722	0.625
Observations	29,140	29,140	29,140	29,140
Panel C: Counties with a Low Share 65+ in the Year 2000				
1{Year ≥ 2004} × **1**{Age = 66}	-0.024***	-0.023**	-0.022***	-0.023
	(0.008)	(0.010)	(0.006)	(0.016)
Pseudo-R^2	0.806	0.779	0.830	0.825
Observations	29,520	29,520	29,520	29,520
Panel D: All Counties				
1{Year ≥ 2004} × **1**{Age = 66}	0.009	0.027	0.013	0.052
× **1**{High Share 65+ in 2000}	(0.016)	(0.019)	(0.012)	(0.039)
Pseudo-R^2	0.800	0.769	0.825	0.804
Observations	58,660	58,660	58,660	58,660

Source: Vital Statistics Mortality Files, 2000-2009.

Note: The dependent variable is the number of county-level deaths in a given year for men (column 1), women (column 2), white individuals (column 3), and Asian, Black, Hispanic, and all other race individuals (column 4). The independent variable of interest is an indicator for the passage of Medicare Part D interacted with an indicator for being aged 66. The estimates in Panels A-C are obtained from equation (4) comparing changes for those aged 66 to the changes for those aged 64. All columns include county fixed effects, county-level demographic and economic controls, and state-by-year fixed effects. Panel A examines all counties, Panel B examines counties that had an above-median share of the population comprised of adults aged 65 or older in the year 2000, and Panel C examines counties that had a below-median share of the population comprised of elderly adults in the year 2000. Panel D examines all counties and is estimated using equation (5) where we interact the independent variable of interest with an indicator for whether the county had a above-median share of the population comprise of elderly adults in the year 2000. This column includes age-by-year, county-by-age, and county-by-year fixed effects. Because they are estimated via a Poisson specification, the results are interpreted as changes in natural log of the dependent variable. Standard errors, shown in parentheses, are clustered at the county level.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$