How Successful Public Health Interventions Fail: Regulating Prostitution in Nineteenth Century Britain *

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January 2024

Abstract

The market for sex is heavily regulated or banned in most jurisdictions, but our understanding of the consequences of regulation remains limited. We study a set of laws passed in Britain in the 1860s known as the Contagious Disease Acts (CDAs) that were aimed at reducing the spread of sexually transmitted infections (STIs). These regulations mandated sex workers undergo routine medical examinations for STIs and gave police the authority to detain women that tested positive for up to nine months. The first part of our analysis shows that the CDAs led to substantial public health improvements. However, these regulations were repealed in 1886. The second part examines the causes of this repeal. Our results show that the success of public health regulations depend not only on the policy's effectiveness, but also on the perceived fairness of the distribution of its costs. These results provide a new perspective on the impact of regulating the sex trade while also improving our understanding of a policy that played a key role in the women's rights movement in the U.K.

*We thank Philipp Ager, Netanel Ben-Porath, Yong Cai, James Feigenbaum, Martin Fiszbein, Claudia Goldin, Eric Hilt, Bob Margo, Lukas Rosenberger and seminar participants at Boston University, Harvard University, the Econometric Society, and the Social Science History Association for helpful comments and conversations. Ashwin Araza and Xueyan Li provided excellent research assistance.

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1 Introduction

Many public health interventions involve a tradeoff between safeguarding the health of a population and protecting individual freedoms. How these two opposing motives are balanced can determine both the extent to which the policy improves public health as well as whether it is successful in maintaining public support. We study this tradeoff in a high-stakes historical setting: the regulation of the sex trade in nineteenth century Britain. Starting in the 1860s, the British state began intervening in what had, up to that point, been an essentially unregulated market for sex. The aim of these new regulations, which were called the Contagious Disease Acts (CDAs) was to reduce the spread of sexually transmitted infections (STIs), particularly among men in the military.

To achieve this aim, the CDAs imposed a rigorous system of physical health inspections on female sex workers, together with mandatory isolation of workers found to be infected with STIs. This system, which was implemented in two locations in 1864, was strengthened and expanded to cover 17 districts across the U.K (including Ireland) by 1870. In each location, police were responsible for registering sex workers. These women were then required to undergo periodic invasive inspections by doctors, around 10 per year on average. Those workers found to be infected with an STI were then detained in a lock hospital for up to nine months. While detained sex workers received medical care in the lock hospitals, the state of medical knowledge at the time meant that treatments (mainly ingesting mercury) were ineffective and actually harmful. However, because sex workers were typically isolated during the most infectious stage of their disease, this system may have reduced overall STI spread.

The CDAs had several features that are useful for our analysis. First, the CDAs were applied to only a subset of locations within the country. The first CDA districts were towns that hosted important Army or Navy stations in southeastern England. The policy was then expanded slowly to stations in other parts of Britain and Ireland. However, in 1870 this expansion was halted due in part to rising public opposition to the acts as well as because administering the program was costly (mainly the provision of lock hospitals). These features allow us to apply a difference-in-difference empirical strategy.

Second, prior to the introduction of the CDAs, the sex trade in the U.K. was largely unregulated. This means we are able to evaluate the effects of the CDAs relative to an unregulated benchmark, something that is difficult to do in modern settings, where the sex trade is either banned or heavily regulated almost everywhere. Third, our setting features a fairly rich set of outcome data that allow us to assess the consequences of the acts along several dimensions.

Fourth, we are able to observe some outcomes before the CDAs were implemented, while they were in force, and after they were eventually repealed in the 1880s. This feature means that in some of our analysis we will be able to compare treated to untreated districts before, during, and after treatment, allowing a particularly strong identification strategy. More importantly, this means that we will be able to analyze the forces that led to the repeal of the CDAs. Efforts to repeal the acts

began soon after they were implemented, spearheaded by Josephine Butler and the Ladies National Association for the Repeal of the Contagious Disease Acts (LNA) that she founded. As we will discuss in more detail later, opposition to the CDAs crystallized around the issue of women's rights. Specifically, forcing women to undergo invasive medical examinations–particularly in conservative Victorian society–was viewed by repealers as a flagrant violation of their rights, a concern that was heightened by worries that women who were not sex workers could be mistakenly registered. Ultimately, these repeal efforts would play an important role in the early women's rights movement in the U.K.

A final useful feature of our setting is that the incidence of the regulation can be clearly identified. For many public health regulations, the incidence of the regulation may be difficult to determine because part of the cost is passed through. In the setting we study, where the main cost was the violation of privacy and forced detention of sex workers, it is clear that the incidence of the regulation fell almost entirely on the sellers of sex. While buyers may have faced higher prices as a result, they also benefited from reduced disease risk.

We begin our analysis by looking at how the CDAs affected the market for sex. Theoretically, the impact of the regulations on the market are ambiguous. While we would expect the burden of the regulation on sex workers to reduce supply, if the regulations improved the safety of purchasing sex they may also have increased demand. Using newly digitized data and both time series and difference-in-difference analysis strategies, we provide evidence that the supply-side effect dominated. Specifically, we find that CDA districts experienced a decrease in both the number of sex workers and the number of brothels as a result of the regulations. The number of registered sex workers in CDA districts declined by approximately 60% while brothels declined by 35%. We also find evidence that the age of sex workers increased after the introduction of the CDAs, consistent with a reduction of entry of younger women into the market. This reduction in the size of the market for sex likely affected the rate of disease spread, in addition to the impact of isolating infected sex workers while they were most infectious.

Next, the main section of our analysis examines the impact of the CDAs on public health using several different outcomes and analysis approaches. In the first set of results, we use newly digitized data on STI infection rates among soldiers at army posts subject to the CDAs compared to those at posts not subject to the acts. These are available for 25 military stations throughout the U.K., only some of which were subject to the CDAs. We find clear evidence of reductions in STI infection rates in treated compared to untreated locations. The hospitalization rate due to syphilis declined by approximately 45% after implementation. This pattern does not appear to be driven by underlying differences between the locations since both types of locations show very similar trends prior to the CDAs.

Next, we examine the impact of the CDAs on STI mortality among the general population. Here, we take advantage of rich mortality statistics from the Registrar General's office. The Registrar General's data include the number of deaths due to syphilis annually at the county level, though

diagnostic challenges mean that this category likely includes some other STI-related deaths. Since syphilis was untreatable during the period we study, our data include a substantial number–over 70,000–syphilis-related deaths. Most of these deaths (around 70-75%) occurred among infants who became infected at birth. Analyzing these syphilis deaths tells us about the impact of the CDAs on an intrinsically interesting outcome while revealing underlying patterns of STI presence in an area.

A key feature of the Registrar General's data is that they are available before the passage of the CDAs, while the acts were in force, and after they were repealed. This off-on-off pattern of treatment allows us to implement a particularly strong identification strategy. In particular, it helps strengthen our analysis against potential identification concerns such as violations of the parallel trends assumption.

Our analysis shows that syphilis death rates fell in counties where the CDAs applied after the acts came into force, while we observe no evidence of differential trends in the pre-treatment period. In terms of magnitude, the syphilis mortality rate declined by approximately 30% after implementation. The reduction in syphilis mortality following the introduction of the CDAs in a location grows over time while the acts were in operation, a pattern that we would expect given that new infections avoided in one period reduce the probability of further infections in the next. However, as soon as the CDAs were repealed, this pattern reverses and syphilis death rates begin converging back toward the rates (relative to the control locations) observed in the pre-treatment period. Within a decade after the repeal, we cease to observe statistically significant differences between syphilis mortality rates in treated compared to untreated locations. In contrast to the patterns observed for syphilis mortality, we do not observe any differential patterns in the two placebo causes of death that we study (cancer and respiratory infections), which provides further support for our identification strategy.

In a third set of results, we examine the impact of the CDAs on the number of childless couples. STI rates may affect the prevalance of childlessness either because STIs cause infertility, because STIs increase miscarriages and infant deaths, or because active infections may cause couples to reduce the frequency of intercourse. To study these effects, we use census microdata from two census waves before the CDAs (1851 and 1861) and two waves after (1891 and 1901) and compare the number of childless couples in locations subject to the CDAs compared to locations not subject to them. We find strong evidence of a reduction in the number of childless couples in CDA districts compared to non-treated districts in the post-treatment census waves. In addition, we also find that couples where either partner was born in a location subject to the CDAs were less likely to be childless. This provides a third set of results indicating that the CDAs had substantial health effects.

Having established that the CDAs had substantial health benefits, in the last part of our study we consider why, despite these, the CDAs were eventually repealed. To examine this issue, we focus mainly on the critical 1883 division (vote) on a resolution against compulsory inspection of

sex workers. When that resolution passed, it eliminated compulsion, effectively gutting the CDAs (they were finally repealed in 1886). We also consider evidence from a second important vote, in 1873, which was the culmination of an unsuccessful early effort to repeal the CDAs. Interestingly, both votes feature substantial crossover voting by both parties.

Our analysis highlights two factors that played an important role in determining MPs vote on the CDAs. One of these is whether the MP actually represented a CDA district. We find very strong evidence that MPs from CDA districts were more likely to support the CDAs. This suggests that direct exposure to the acts, and their effects, increased support for the intervention. A second critical factor was concern for women's rights. We find that support for women's rights–which we measure using MP votes on resolutions or bills related to women's suffrage or married women's property laws–strongly predicts opposition to the CDAs. A back-of-the-envelope calculation suggests that concerns about women's rights was critical to the repeal of the CDAs, a finding that is supported by our review of historical evidence.

Finally, we provide more causal evidence that concerns about women influenced the votes of MPs (who were all men). To do so, we carefully reconstruct the fertility history of each MP, by manually matching individuals to censuses and other sources, in order to identify the number of sons and daughters that each had as of the 1881 census. We then hypothesize that the presence of daughters increases MPs concern about women's rights issues relative to sons.[1] To verify that this is the case, we show that MPs with daughters were substantially more likely to vote in favor of women's suffrage in the 1883 division. Then, we show that MPs with daughters were substantially more likely to vote to repeal the CDAs than MPs with sons. Since the number of daughters or sons that MPs had was as good as random in the population we study, this provides direct evidence that concerns about women influenced MP votes against the CDAs.[2]

Two primary messages emerge from our analysis. First, introducing a regulatory system that involves health inspections of sex workers and isolation of workers with STIs can substantially improve public health relative to a laissez-faire environment. Second, the success of such a public health intervention depends not only on its effectiveness in improving health outcomes, but also on the perceived fairness in how the costs of the intervention are distributed. Most public health initiatives come at some cost. In the case of the CDAs, the design of the acts was such that the cost was entirely born by female sex workers; if anything, the acts likely benefited male sex purchasers, by making the purchase of sex safer. This came to be widely viewed as unjust, leading ultimately to the failure of the CDAs.

It is important to recognize that it was not inevitable that the CDA regulations would take such a biased and compulsory form. At least two other approaches were discussed. One alternative

[1] This approach is inspired by Washington (2008).

[2] There is no evidence that selective abortions or infanticide were carried out in the U.K. during this period, and among MPs, which were universally wealthy relative to the British population, it is highly unlikely that a gendered allocation of scarce resources among children would have led to higher mortality rates among female relative to male children. Consistent with this, we find almost perfect gender balance among the children of MPs.

involved a system that also imposed an inspection regime on soldiers, one of the primary groups of sex purchasers. However, this alternative was deemed "extremely distasteful."[3] Another alternative, advocated by the LNA, was the provision of "ample free hospital accommodation", preferably staffed mainly by women doctors, where infected sex workers could seek care and treatment.[4] Both of these alternatives were rejected in favor of the system implemented by the CDAs.

Related literature and contribution: Our paper contributes to an extensive literature on historical mortality patterns and the role of public health interventions aimed at improving health during the nineteenth century. This is a very large literature, including work on topics ranging from digestive diseases and water supply improvements (Troesken, 2004; Cutler and Miller, 2005; Ferrie and Troesken, 2008; Beach et al., 2016; Alsan and Goldin, 2019; Anderson et al., 2020, 2021; Beach, 2022; Anderson et al., 2022; Chapman, 2022, 2019), food quality (McKeown, 1976; Anderson et al., 2023), public health efforts aimed at tuberculosis (Anderson et al., 2019; Clay et al., 2020; Egedesø et al., 2020), lead exposure Clay et al. (2014), vaccination (Ager et al., 2018), interventions aimed at limiting the spread of influenza such as mask mandates and school closures (Markel et al., 2007; Correia et al., 2022; Dahl et al., 2023), and other medical interventions (Ager et al., 2023).

Despite the breadth of this literature, STIs and public health interventions aimed at limiting them remain almost completely unexplored. This is particularly surprising given that STIs were an important cause of death, infertility, and likely had even larger morbidity effects (Siena, 2004; Szreter, 2014; Szreter and Schürer, 2019). One exception is Fung and Robles (2016) which studies mandatory antenatal testing for syphilis which was adopted in many U.S. states in the 1940s. There is recent work in demographic history that is starting to highlight the significance of syphilis as a public health issue historically. Using hospital admissions records, Szreter and Siena (2021) estimates that a man in London in the 1770s would have a 20% chance of contracting syphilis by age 35. Our paper is the first in economics to study how interventions in the sex trade affected public health in the historical context when the prevalence of STIs was very high.

More broadly, our paper differs from most existing work on public health interventions in that we go beyond evaluating the efficacy of the intervention on public health, to also consider how the distribution of the burden of the interventions affects public support and, ultimately, the longevity of the policy. Our findings demonstrate that the ultimate success of the policy depends not only on whether it improves health, but also on whether the burden of the intervention is distributed in a way that allows it to maintain public support. This result naturally has implications for modern public health interventions.

We also contribute to a narrower literature focused on the costs and benefits of regulating the sex

[3]Specifically, the Duke of Cambridge told the Venereal Disease Committee that, "'I have consulted with the Director-General of the [Army] Medical Department..." who thought that the inspection of soldiers was "extremely distasteful, and was considered a very offensive duty by the Medical Officers of the Army; and further, that the advantages to be gained by it did not compensate for the discomfort and distaste that was felt by the Medical Officers." See *Report of the Committee appointed to enquire into the Pathology and Treatment of Venereal Disease*, 1868, Parliamentary Papers, p. xxxii.

[4]Butler (1909), p. 45.

trade. This strand of literature is small but growing rapidly. Recent examples of work in this vein include Gertler and Shah (2011), Bisschop et al. (2017), Cunningham and Shah (2017), Cameron et al. (2021), Gao and Petrova (2022), and Ciacci (2023).[5] Relative to existing work in this area, our study expands our understanding of the consequences of regulating the sex trade in several dimension. First, we are the first to examine the impact of imposing a system of registration and inspection in a laissez-faire environment. Second, we are able to study how the impact of regulation evolves over several years, as well as the consequences of subsequently eliminating regulation. This features allow us to provide some new results that enrich our understanding of sex trade regulations. For example, we show that the CDAs reduced STI prevalence in regulated locations, but once the regulation were repealed STI rates in treated locations began converging back toward the (relative) rates observed before treatment. So, while reducing STI rates in some locations had a persistent effect, the half-life of that effect was rather short.

Finally, our paper provides the first quantitative evaluation of a policy that played a key role in the early women's rights movement in the U.K. Most existing literature on the CDAs has been done by historians and sociologists such as Blanco (1967), Sigsworth and Wyke (1972), Walkowitz and Walkowitz (1973), and Walkowitz (1982). Their interest is motivated by the important role that resistance to the CDAs played, through the work of activists such as Josephine Butler and organizations such as the Ladies National Association for the Repeal of the Contagious Disease Acts (LNA), in the early women's rights movement in the U.K. Relative to work in this vein, we offer new data and a more quantitative evaluation of the impacts of the CDAs as well as the motivations behind their ultimate repeal.

The rest of the paper proceeds as follows. Section 2 presents historical background. Section 3 presents results on how the CDAs affected the market for sex. Section 4 presents our main empirical results on how the CDAs affected public health. Section 5 analyzes the reasons why the CDAs were repealed. Section 6 concludes.

2 Background

This section provides historical context for our study. The first part discusses the passage and implementation of the Contagious Diseases Acts. The second part discusses opposition to the CDAs which resulted in the repeal of the acts. The third part provides a summary of the medical knowledge and available treatments for STIs in the nineteenth century.

[5]These empirical studies are motivated, in part, by theoretical work highlighting the trade-offs inherent in sex work. A seminal theoretical contribution in this area is Edlund and Korn (2002). More recent theoretical work includes Immordino and Russo (2015), which focuses on how policies toward the sex trade affect health risks, and how those risks, in turn, influence the market, and Lee and Persson (2022), which emphasizes the fact that the sex trade involves both voluntary and coerced workers. A slightly different line of work examines the factors that determine the size and spatial distribution of the market for sex. An example of work in this vein is Brodeur et al. (2018).

2.1 The Contagious Diseases Acts

Before the passage of the Contagious Diseases Acts solicitation by sex workers was not criminalized in Britain (Walkowitz, 1982, p.14). Officials treated prostitution as a public nuisance and were primarily interested in containing it within particular areas of cities. This policy of geographically segregating sex work was common in other contexts as well, such as in U.S. cities in the late nineteenth century (Goehring, 2023). In contrast to these more passive approaches, the CDAs resembled systems developed in France and Germany in the early nineteenth century in which sex workers were required to undergo periodic medical inspections. These systems provided a model for the system eventually adopted, in a more limited form, in the U.K. (Harsin, 1985).

The motivation behind Britain's Contagious Disease Acts can be traced to the Crimean War of 1854-1856. The death of substantial numbers of British soldiers due to poor sanitation and health care, rather than enemy action, was highlighted through the work and advocacy of Florence Nightingale, other reformers, and journalists. This led to a rethinking of how soldiers were treated, leading to the appointment of the Army Sanitary Commission in 1857.[6] Among the health concerns highlighted by this commission were high rates of STIs among soldiers.

The initial Contagious Diseases Act was passed in 1864 with the primary objective of reducing the prevalence of STIs among British troops. The 1864 act applied to eleven areas containing military garrisons, eight in England and three in Ireland. Subsequent amendments in 1866 and 1869 expanded the geographic scope of the act and broadened the powers police had to force sex workers to comply with the law. Each act added districts to the CDAs and extended the length sex workers could be detained in hospitals. By 1870, the CDAs were enforced in 18 subjected districts (CDA districts) located in the southern part of England as well as parts of Ireland. Appendix Table B.1 lists these locations and the year in which the CDAs came into force in each.

It is notable that both the original 1864 act and the acts of 1866 and 1869 were passed without either substantial debate or a division. In other words, the laws were passed without a vote in Parliament.[7] This means that there are no votes on the initial enactments to analyze. This feature became an important point of criticism once resistance to the CDAs arose. It also means that we have no votes on the enactment of the CDAs to analyze.

After the final amendment in 1869, the system for regulating sex work operated in the following manner.[8] Police in subjected districts were tasked with identifying and registering all sex workers. If a woman was suspected of engaging in sex work, the police would register her and the local court would issue a summons for her to report for a medical examination. If, upon examination,

[6] Blanco (1967).

[7] That an Act can pass without a vote may seem surprising to those not familiar with the workings of the U.K. Parliament. As Parliament's website explains, "When a vote is held the Speaker in the Commons - or Lord Speaker in the Lords - asks Members to call out whether they agree or not. The Speaker will then judge whether there is a clear result. If this cannot be determined, the Speaker or Lord Speaker calls a division" (see https://www.parliament.uk/about/how/business/divisions/).

[8] Our description of the CDAs is based in part on the Report of the Select Committee on the Contagious Disease Acts of 1882 as well as Sigsworth and Wyke (1972, p.94-95).

no STI was identified, she was free to continue working until her next examination. However, if she was found to have an STI she could be detained at the lock hospital for up to nine months. The duration of medical inspections would last a year, after which, if the woman still engaged in sex work and the police wanted to continue subjecting her to examinations, they would have to reregister her and seek new court approval. Sex workers could voluntarily submit to the law as well to avoid the judicial summons. If a woman wanted to be removed from the register to avoid future inspections before the year had elapsed she was entitled to a hearing in which she had to prove that she no longer engaged in sex work. Women that did not comply with the law could be forcibly detained. As a means of ensuring compliance with the system of licensing and inspections, the CDAs also gave the police the power to fine and arrest brothel keepers as well as the owners of other establishments where unregistered women practiced sex work.

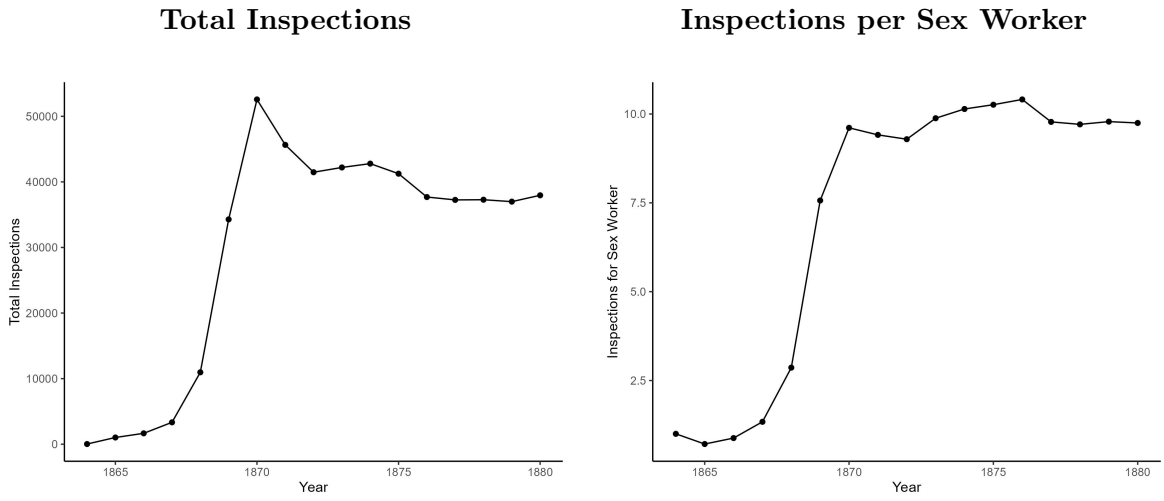
The CDAs were vigorously enforced in most subject districts. Police swept the streets, brothels, and other establishments (beer houses, public houses) to identify and register sex workers so that they could be tracked and subject to periodic medical examinations. These enforcement mechanisms became more effective over time, as local authorities gained experience. Using police records we digitized from the Parliamentary Papers, Figure 1 describes the number of inspections undertaken across all subjected districts. Between 1864 and 1870, the number of inspections increased as new districts were brought under the CDAs and the enforcement mechanism in existing districts became more comprehensive. In 1870, around 50,000 inspections (medical exams of sex workers) were conducted. After 1870, the number of inspections fell, leveling off at around 40,000 per year. By comparing the left and right-hand panels in Figure 1, we can see that the reduction in the total number of inspections was driven by a reduction in the number of sex workers active in the subject districts, a finding that we examine in more detail later, while the overall number of inspections per sex worker remains fairly constant at around ten per year. These inspections were backed up by an effective system of isolation for those workers who showed signs of having an STI. Between 1870 and 1880, the total number of hospitalizations ranged from 3,000 to 5,000 per year (see Figure C2). Overall, these patterns highlight the expansive scope of the CDAs, as well as the impressive level of state capacity involved in registering, inspecting, and isolating infected women.

2.2 Opposition to the CDAs

Public criticism of the CDAs started soon after they were adopted. Several organizations were formed to lobby for their repeal, the most influential of which was the LNA. Josephine Butler started the LNA in 1869 and used it to wage a public campaign to remove the CDAs. The clearest demonstration of the principles of this opposition is provided by the text of a protest letter published by the LNA at the end of 1869, which we reproduce in full in Appendix A.1.

There were three common critiques raised by the LNA and others in opposition to the acts. First, many critiques focused on the degrading and intrusive nature of the physical examinations that invaded the privacy of the women subject to them. The protest letter articulated this point by

Figure 1: Medical Inspections under the CDAs Over time



Note: The figure on the left displays the total number of medical inspections of sex workers conducted from 1864-1880. The figure on the right displays the number of medical inspections relative to the number of sex workers examined. Both graphs aggregate across all districts. The data are from the *Annual Report of the Assistant Commissioner of the Police of the Metropolis Relating to the Contagious Diseases Acts* in 1881. Appendix B.1 provides additional details.

saying, "these measures are cruel to the women who come under their action–violating the feelings of those whose sense of shame is not wholly lost, and further brutalising even the most abandoned."

Beyond the intrusive and degrading treatment of sex workers, a second concern was that women not engaged in sex work had little recourse if police suspected them of being prostitutes. The protest letter argued it was "unjust to punish the sex who are the victims of a vice, and leave unpunished the sex who are the main cause both of the vice and its dreaded consequences; and we consider that liability to arrest, forced medical treatment, and (where this is resisted) imprisonment with hard labour, to which these Acts subject women, are punishments of the most degrading kind." In arguing against the CDAs, Butler often recounted the story of Mrs. Percy, a woman working in a musical theater on one of the military bases in a subjected district. Her sixteen-year-old daughter would accompany her to work, and one night they were stopped by the local morals police. She tried to convince the officers that they were not prostitutes, yet the police were unconvinced and wanted to register her and her daughter for medical inspections. Mrs. Percy refused to sign the registration paperwork leading to a series of retaliations by the police in which she lost her job, left the district, tried to regain employment in the district under an alias, and was continually pursued by the police. While an extreme case, Mrs. Percy's story illustrates the broad powers given to local authorities under the CDAs and the potential for police overreach (Barry, 1984, p.17-18).

A third critique that permeates much of the protest letter and other discourse among opposition leaders is that the law was unfairly applied only to women and not men. The protest letter describes the "momentous change in the legal safeguards hitherto enjoyed by women in common with men"

which "'so far as women are concerned...remove every guarantee of personal security which the law has established and held sacred, and put their reputation, their freedom, and their person absolutely in the power of the police."[9]

To oppose the CDAs, the LNA recruited sympathetic MPs to lead repeal efforts in Parliament, such as William Fowler, a Quaker, and the Radical Liberal James Stansfield. The LNA held numerous public meetings and rallies, and during key debates often organized women's prayer meetings near Parliament.[10] While these efforts were rebuffed throughout the 1870s, they were eventually successful in eliminating compulsory examination in 1883 and completely repealing the CDAs in 1886. Section 5 studies the key votes in more detail.

Historians have highlighted the important role that opposition to the CDAs played in the women's rights movement during the Victorian era. Feminist historian Barbara Caine writes that "some would argue that the real turning point" in the feminist movement "was not so much the early campaigns of the 1850s and 1860s as the contagious disease agitation, which...dominated feminist consciousness during the 1870s. The campaign...soon involved a national movement with a substantial membership, working through large-scale public meetings and demonstrations, direct political intervention in by-elections, and by producing effective propaganda."[11] One reason for the movement's impact was how, "drawing on the model of the abolitionist movement, it...developed a powerful religious rhetoric which tied its specific legal objective, the end of the Contagious Disease Acts, with an ideal of moral and religious transformation–and the end of the sexual double standard."[12]

2.3 STIs in the Nineteenth Century

Contemporaries had some understanding of the most common STIs in the second half of the nineteenth century, but with important gaps in their knowledge. An excellent source that reveals the level of their understanding is the report of a Committee appointed in 1864 by the Admiralty and the Secretary of State for War to survey the state of medical knowledge on STIs and what could be done to reduce their spread. This "Venereal Disease Committee", which included representatives of both the Army and Navy Medical Boards as well as leading private physicians, interviewed 56 leading medical professionals and provided a detailed report summarizing current medical knowledge related to STIs.[13]

Contemporaries understood that STIs such as syphilis–the most important STI in the context we study–were in fact real diseases (a fact which had been disputed by some) but they had trouble

[9] From Butler (1909). See Appendix A.1 for the full text.

[10] See Butler (1909), p. 79. At one such meeting, just before the crucial 1883 vote, Josephine Butler described "well-dressed ladies, some even of high rank, kneeling together (almost side by side) with the poorest, and some of the outcast women of the purlieus of Westminster."

[11] Caine (1997), p. 90-91.

[12] Caine (1997), p. 91.

[13] The final report is *Report of the Committee appointed to enquire into the Pathology and Treatment of Venereal Disease*, 1868, Parliamentary Papers. According to the report, the Committee also forwarded preliminary findings to Parliament in 1866, which played a role in the passage of the 1866 Contagious Disease Act.

precisely identifying different STIs. The Committee found syphilis was a disease "universally recognized by the medical profession" though "the term 'Syphilis' at the present day includes every variety of constitutional venereal disease."[14] This point indicates that the data on syphilis used in our analysis may be capturing a wider variety of STIs.

The report also reveals a basic understanding of the progress of syphilis through its various stages. Syphilis is most contagious during the first stage of the disease in which the infected individual has a sore that normally lasts up to six weeks. In the second stage, the sore heals and is usually followed by a rash. After the rash has disappeared the individual enters tertiary syphilis, and is normally no longer contagious. This stage can last years and lead to cardiovascular and neurological issues.[15] An understanding of these stages allowed contemporary doctors to diagnose the disease. However, this diagnosis relied on physical inspection, since medical advances allowing effective testing for syphilis were not invented until the early 1900s, well after our period of interest.[16]

While the diagnostic characteristics of the disease were well-understood, the etiology of the disease was not. It was understood that syphilis and other STIs could be spread through contact, but debate remained over whether it could also appear spontaneously. Moreover, the exact mechanism of spread was not well understood. However, it was understood that STIs could be transmitted through sexual intercourse, and contemporaries also knew that some, syphilis in particular, could spread from infected mothers to their infants at birth. This "hereditary syphilis" was known to cause stillbirths and to kill many infants and young children.[17]

While contemporaries could generally diagnose STIs, they had almost no ability to effectively treat them. Simple primary syphilis sores, for example, were treated by "local applications" (compresses) to "allay pain or inflammation."[18] For more serious cases, the primary treatment was mercury "by mouth, by inuction, or by vapour baths." The committee found that "The weight of the evidence...preponderates in favour of the advantage of mercurial treatment..." though "it is contended by a minority of authorities that mercurial treatment...neither prolongs the interval of apparent health, nor modifies the severity of the future disease."[19] The main alternative to mercury was ingestion of iodine. Neither of these approaches would have been therapeutic and neither would be recommended today. Effective treatments would not arrive until 1909, when an

[14] *Report of the Committee appointed to enquire into the Pathology and Treatment of Venereal Disease*, 1868, Parliamentary Papers, p. vi.

[15] This webpage from the Center for Disease Control provides a useful summary of the different stages of syphilis as well as information on its contagiousness and side effects: `https://www.cdc.gov/std/syphilis/stdfact-syphilis-detailed.htm`

[16] In 1905, German researchers identified the bacteria that causes syphilis. A year later the Wassermann test was invented which became the most common way to identify syphilis infection. (Brandt, 1985, p.40-41)

[17] *Report of the Committee appointed to enquire into the Pathology and Treatment of Venereal Disease*, 1868, Parliamentary Papers, p. xi.

[18] *Report of the Committee appointed to enquire into the Pathology and Treatment of Venereal Disease*, 1868, Parliamentary Papers, p. xvi.

[19] *Report of the Committee appointed to enquire into the Pathology and Treatment of Venereal Disease*, 1868, Parliamentary Papers, p. xvi.

arsenic-based treatment known as Salvarsan became available. However, the drug was toxic and led to complications for early patients. A safer version of the drug was invented in 1912, and became the main treatment for syphilis in place of mercury (Brandt, 1985, p.40-41). Penicillin, the modern treatment, did not become widely used until the 1940s (Alsan and Wanamaker, 2018).

The Report's limited discussion of methods of preventing the spread of syphilis is also revealing. The main method of prevention discussed was reducing contact between infected and non-infected persons through identifying and isolating those with infections. Thus, while the medical officials examining sex workers as part of the CDAs could not have cured their syphilis, they could have identified women with sores and rashes which would indicate they were still in the contagious period of the disease. Other modern methods for reducing STI spread, such as condoms, were not widely available in the period we study.[20] Beyond isolating infected individuals, the only other method seriously recommended for preventing spread was the provision of facilities for washing after intercourse.

3 Preliminary analysis: The CDAs and the Market for Sex

As a first step in our analysis, we analyze the impact of the CDAs on the market for sex. This analysis provides an indication of how the quantity of sexual transactions changed as a result of the policy, which is one important channel through which the policy affected public health.

The impact of the CDAs on the quantity of sex transacted is theoretically ambiguous. On one hand, the CDAs represented an increase in the cost and hassle faced by women who sold sex. Sex workers incurred time costs associated with the frequent inspections. The history literature also suggests the examinations were mentally taxing for sex workers. Many did not want to be examined and considered it to be a breach of privacy. In addition, the police actively worked to discourage sex workers from practicing the trade, particularly those new to it, and to connect sex workers with resources that helped them exit the trade. We would expect all of these factors to shift supply downward. On the other hand, if the CDAs increased buyers perception of the safety of purchasing sex, then they might also have increased demand.[21] We would expect both of these forces to increase the price in the market (which unfortunately we are unable to observe) but the effect on quantity–which is what matters for disease transmission–is ambiguous.

Data We use two sources of data to track the impact of the CDAs on the market for sex. The first, which was produced by the police as part of the CDA intervention, we digitized from the *Annual Report of the Assistant Commissioner of the Police of the Metropolis Relating to the Contagious Diseases Acts* for 1881 (hereinafter the "police data"). The advantage of this data source is that it contains detailed information on the sex trade in each district subjected to the

[20] Vulcanized rubber was first used in condom production in 1855. However, condoms remained expensive, and thus rarely used, well into the twentieth century (Guinnane, 2011).

[21] Immordino and Russo (2015) present a model of the sex trade capturing these various elements. The health risk in the market is endogenous to the number of sex workers and clients. They study how various regulations of the sex trade, either prohibition or licensing regimes, impact equilibrium quantities, prices, and health risk.

CDAs. The disadvantage is that it is available only for these treated districts, and only starting from the year the act came into effect. Additional details on these data are provided in Appendix B.4.

To complement the police data, we use a second data set–the "brothels data"–which we digitized from the *Judicial Statistics of England and Wales*. These data reports the number of active brothels in British counties from 1860 to 1871.[22] The main advantage of this source is that it contains data for both CDA and non-CDA locations before and after the introduction of the CDAs, allowing us to conduct a difference-in-difference analysis. The main disadvantage of this data set is that we see only the number of establishments active in a location, rather than the number of sex workers.

There are some caveats that should be kept in mind when using both of these data sets. First, the data reflect only the number of sex workers and brothels known to the police through the registration process. They do not capture women that evaded the law and continued practicing sex work. However, as we have seen, the CDA regulatory regime was quite extensive, and so there are unlikely to be substantial numbers of unregistered women selling sex in the subject districts. Second, the number of sex workers or establishments is not a perfect measure of the quantity in the market, because it will not capture the intensive margin of supply. However, we believe that it is likely to be a good approximation of quantity because most of the women who sold sex (at least those captured in our data) did so on a full-time basis.[23] There is a clear economic rational for this, as pointed out by Edlund and Korn (2002).

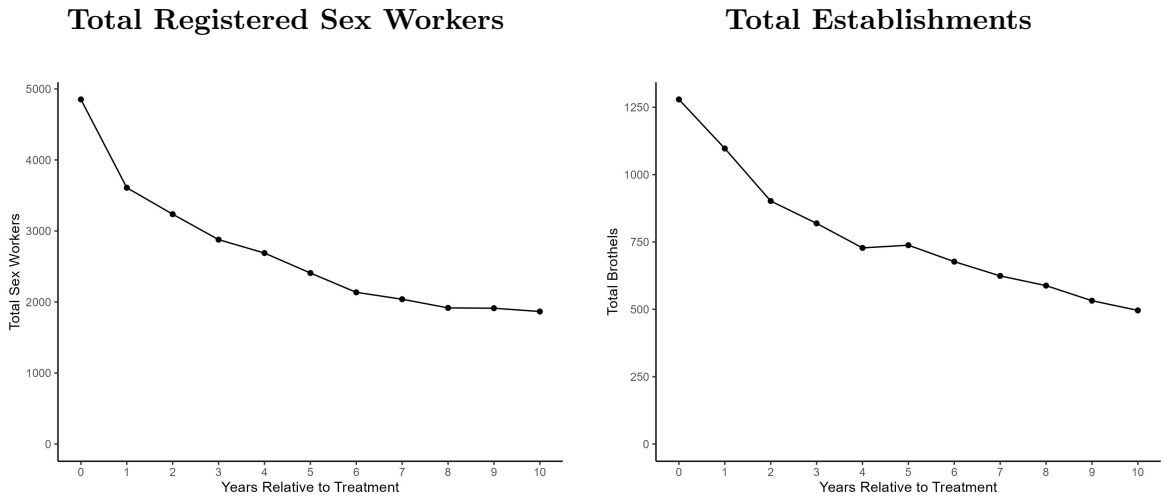
Analysis of the police data: We start by using the police data to provide a series of descriptive facts on how different aspects of the sex trade changed over time in the treated districts. As a starting point, Figure 2a shows the change in the number of sex workers in CDA districts in event time, i.e., relative to the first year in which the district came under the CDAs and the sex workers in the district were registered. The reduction in sex workers over the first few years in which the CDAs were in operation is clear. Starting from a total of nearly 5000 women in the initial year, the number of sex workers in CDA districts dropped to around 2000 after about five to seven years and then leveled off. Overall, this represents an approximately 60% reduction in the number of sex workers during the period. This drop is observable in nearly all of the CDA districts, as shown in Appendix Table C1, though there is some variation resulting from the particular circumstances in each district as well as the vigor with which the regulations were enforced. The fact that we observe such a precipitous drop in the number of sex workers following the introduction of the CDAs strongly suggests that the new regulations effectively reduced the size of the sex trade.

The reduction in the supply of sex workers coincides with a similar decline in the number of establishments where the sex trade took place. Figure 2b shows that the total number of estab-

[22] For unknown reasons, after 1871 the number of brothels is no longer reported in the Judicial Statistics reports.

[23] When discussing the prevalence of women that engaged in sex work only part-time, the historian Judith Walkowitz writes, "Experts doubted that working women could maintain a dual identity over any extended period – slaving away fourteen hours a day at dressmaking or launderessing and then going on the streets in the evening." (Walkowitz, 1982, p.14-15)

Figure 2: Registered Sex Workers & Brothels in Subjected Districts



Note: The figure on the left displays the total number of registered sex workers over time. The figure on the right displays the total number of establishments where sex work took place. Both graphs aggregate across all districts in event time. The data are from the *Annual Report of the Assistant Commissioner of the Police of the Metropolis Relating to the Contagious Diseases Acts* in 1881. Appendix B.1 provides additional details.

lishments declined by approximately 60% in the first decade after implementation. Furthermore, the types of establishments also changed. In the first year the CDAs were implemented, public and beer houses comprised approximately 32% of locations. Some of these pubs would rent out permanent housing for women to reside in the bar while other sex workers resided elsewhere. A decade later, the share of public and beer houses had declined to approximately 7%. Overall, these facts reflect the reduction in the size of the market as well as the formalization of the sex trade as sex work concentrated in brothels and away from locations such as public and beer houses where other types of leisure activity occurred.

The police data also offer insight into the mechanisms through which the reduction in the number of sex workers occurred. As part of the registration process local police collected data on the age of all registered sex workers in subject districts. Appendix Figure C1 shows the age distribution aggregated across districts for the first year after treatment and a decade after treatment. There is a clear rightward shift in the distribution with more women in their twenties and thirties indicating sex workers became older over time. During this period the average age increased nearly 4 years from 21 to 25. While it is impossible to know with certainty given available data, this fact is consistent with a reduction in younger women entering the sex trade and existing sex workers remaining in the market for longer. Younger women choosing whether to enter the sex trade might have been dissuaded given the higher costs associated with frequent testing, or because of police interventions encouraging them not to enter, whereas the sex workers that remained may have been those with few outside options. The historians Judith and Daniel Walkowitz have presented anecdotal evidence of this fact and have argued that the CDAs led to the "professionalization" of

the sex trade where women remained in the industry longer and had less occupational mobility (Walkowitz and Walkowitz, 1973).

Lastly, with the police data it is possible to study what happened to some of the sex workers that chose to exit the sex trade after the CDAs were implemented. Sex workers were registered with the police for a period of a year during which they underwent frequent inspections. If a woman wanted to be removed from the registry before the year elapsed they were required to prove they no longer engaged in the sex trade. The police data contain the reasons why women were removed from the registry. The most common reason was because they simply left the district. Nearly 52% of removals were because sex workers migrated to other locations. We will return to this fact later in the analysis when we discuss potential health spillovers to other geographic areas. Around 42% of sex workers either moved in with friends or entered homes where they worked in other occupations. Only 5% of women left the sex trade through marriage. This is consistent with other work suggesting sex workers incur stigma costs from being associated with the sex trade that hurt their marriage market prospects (Edlund and Korn, 2002).

Analysis of the brothels data: While the police data provide detailed information on the sex trade in the treated districts, a potential concern is that the observed declined in supply could be driven by other confounding factors. To address this, we use the data from the *Judicial Statistics* that report the number of brothels for British towns and counties from 1860-1871. We then use a difference-in-difference empirical strategy to assess how supply, proxied by total brothels, changed in response to the CDAs.

We estimate the following equation:

$$y_{ct} = \alpha + \sum_{s} \beta_s \mathbf{1}\{s = t - \tau_c\} + \alpha_c + \alpha_t + \epsilon_{ct} \tag{1}$$

where $\mathbf{1}\{s = t - \tau_c\}$ is an indicator equal to one for county c in the s'th year relative to when the county was treated in τ_c, and zero otherwise. β_s is estimated for each year s relative to treatment which allows us to assess the existence of pre-trends. α_c and α_t are county and year fixed effects, respectively. The main outcome, y_{ct}, is the number of brothels in the county.

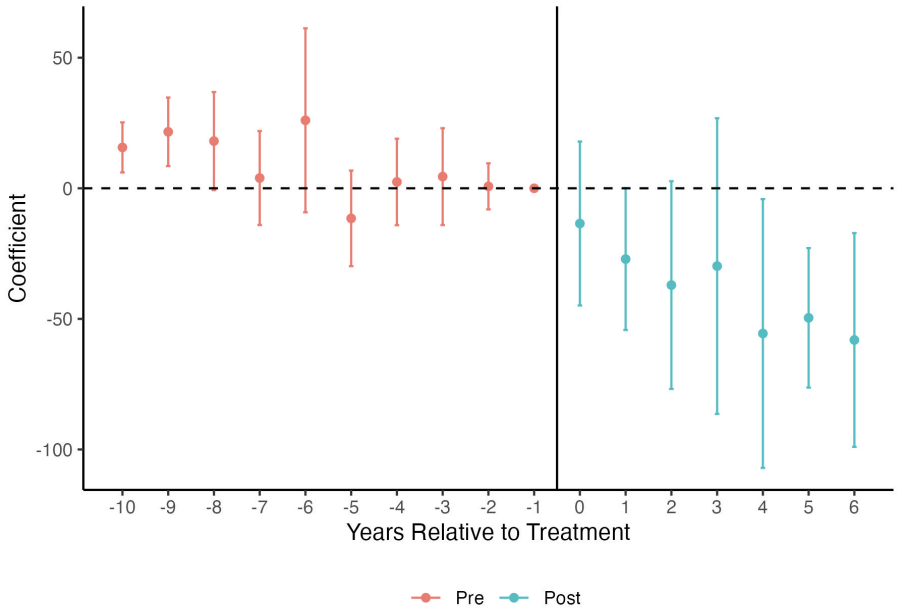
There are a few aspects of this empirical strategy to note. First, we estimate equation (1) at the county-level, so the timing of treatment, τ_c, is defined as the first year any treated district contained in the county becomes subjected to the CDAs. Note that counties are substantially larger than districts. One implication of this is that our estimates will capture the net effect of the treatment in CDA districts as well as any spillover effect from treated districts into neighboring districts in the same county. This feature helps address a potential concern that our results may be affected by spillovers from treated into non-treated neighboring districts. In Section 4.3 we will provide evidence indicating that spillover effects into nearby districts were not meaningful.

Second, treated counties are subjected to the CDAs at different times (see Table B3). There has been a recent literature highlighting issues with the common two-way fixed effect approach when

treatment timing is staggered and effects are heterogeneous (Baker et al., 2022). Therefore, we will estimate equation (1) using the estimator in Callaway and Sant'Anna (2021) which addresses the negative weighting issue in two-way fixed effects with staggered treatment timing. When using this estimator the researcher must choose if only never-treated units are in the control group or whether not-yet-treated units are also added. We choose to only include never-treated units so that the composition of the control group does not change over time.[24]

Figure 3 displays the event study results from estimating equation (1) using the method in Callaway and Sant'Anna (2021). While noisy, the estimated coefficients suggest treated and control counties are not trending differently prior to implementation of the CDAs. After implementation the number of brothels in counties containing treated districts begins to decline. Appendix Table C2 provides the average treatment effect corresponding to the results presented in Figure 3, as well as some robustness checks. The average effect implies that after the CDAs were implemented treated counties had approximately 39 fewer brothels, a 37% reduction for the average county.

Figure 3: The Effect of the CDAs on the Number of Brothels



Note: The figure shows the estimated coefficients and 95% confidence intervals for β_s in Eq. 1 estimated using the method from Callaway and Sant'Anna (2021) applied to the county-level number of brothels. The x-axis is in event time relative to the year in which the CDAs became active in any district within the county. The vertical line corresponds to the year of treatment. Standard errors are clustered at the county-level.

Summary: Both the patterns revealed by the police data and our analysis of the brothels data

[24]Throughout the analysis we choose to use never-treated units as the control group. However, results are robust to using not-yet-treated units instead. This is partially because in our context we have few treated counties (6 out of 45) so the never-treated and not-yet-treated control groups are quite similar.

indicate that the CDAs substantially reduced the size of the market for sex in the districts in which they applied. A reduction in the size of the sex market is one factor that can affect the spread of STIs. A second related factor, which we also documented, is the isolation of infected sex workers under the CDAs (see Figure C2). Next, we examine how these changes impacted public health.

4 Main analysis: Health effects of the CDAs

This section presents our main analysis, which assesses the effect of the CDAs on health. The analysis is divided into several parts, each of which uses a slightly different outcome measure and analysis strategy. We begin by looking at whether the acts reduced STI cases among soldiers, their primary aim, using data collected from military reports. Then, we consider the impact on STI mortality in the general population using the national mortality statistics. Finally, we look at how the acts affected the rate of childless couples, using census microdata.

4.1 The Impact of the CDAs on STI cases among soldiers

Question: Were the CDAs effective at reducing STI prevalence among soldiers stationed in the locations where the CDAs were applied? Answering this question will tell us whether the CDAs achieved their primary objective. It also provides a natural preliminary step toward assessing the effects of the CDAs on the broader health outcomes among the general population.

There are several reasons why the CDAs may have reduced STI prevalence in treated districts. First, as we have seen, there is evidence that the overall size of the sex market fell. To the extent that this market was an important source of STI spread, we would expect this to lead to a reduction in STI prevalence. In addition, within the sex market, the isolation of sex workers with STI symptoms should have reduced the overall risk of STI spread from any particular sex transaction. However, STI rates may not have fallen if either the sex trade was not a primary driver of the spread or if sex buyers obtained sex in other ways that also came with equivalent STI risks.

Data: To assess changes in the spread of STIs we have collected and digitized data on the number of soldiers hospitalized with STIs at military stations in the UK (which included all of modern Ireland at this time) from 1860 to 1878. The data come from a report by a committee in Parliament that was investigating how the CDAs were operating in the subjected districts. The report contains information on the hospital admissions of soldiers from various STIs. For gonorrhea and primary syphilis, only data aggregated across treated and untreated stations is reported. However, for secondary syphilis the report provides disaggregated hospital admissions for 27 larger military stations. We drop two of these stations, Warley and Windsor, which do not report data for the entire period. Thirteen of these stations are located in a subjected district and

12 in untreated districts.[25] These data cover all Army stations with over 500 men.[26] Additional details on these data are provided in Appendix B.2.

Analysis strategy and results: The structure of our data on secondary syphilis allows us to use a difference-in-difference analysis strategy comparing syphilis hospitalization rates in stations in treated versus untreated stations before and after the introduction of the CDAs. Our basic estimating approach follows equation (1) except that the unit of observation is the station rather than the county. The outcome in this regression is the log of the hospitalization rate defined as the number of annual hospitalizations from syphilis per 1,000 soldiers at the station.

Since treated stations were subjected to the CDAs at different times, we estimate results using the estimator in Callaway and Sant'Anna (2021). Appendix section B.2 lists the stations in the data and the timing of treatment. Throughout the analysis when reporting event studies we estimate the dynamic treatment effects, β_s, for years in event time where all treated units have available data. We do this so that changes in the dynamic treatment effects are not being driven by the composition of treated units over time.

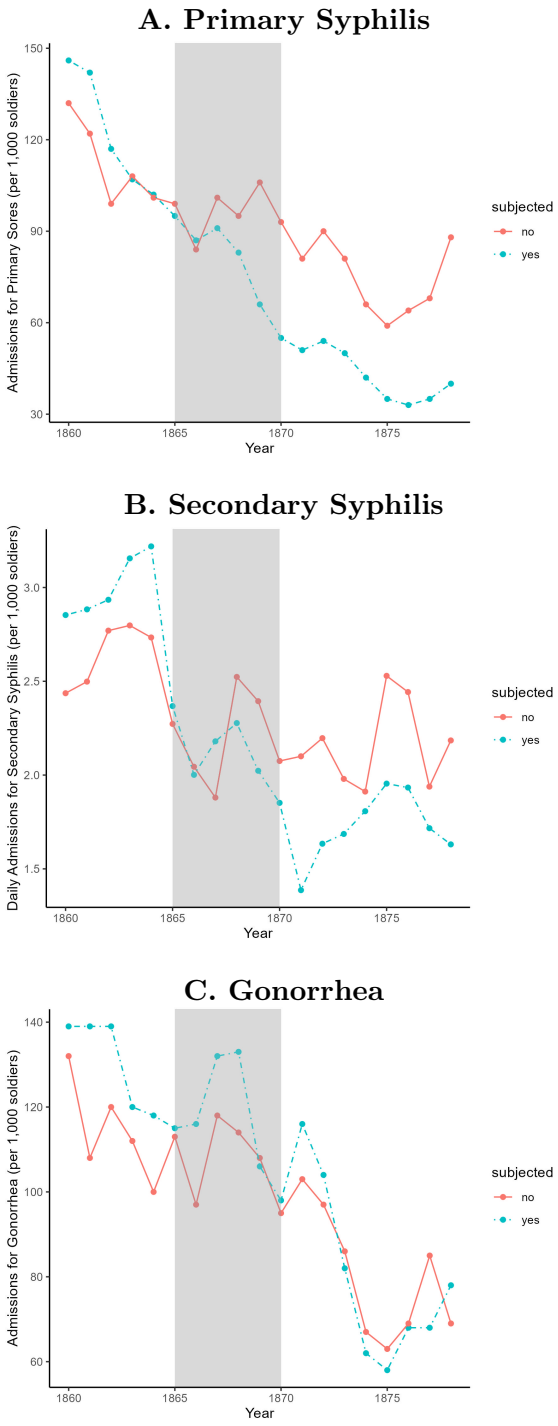
Before moving to our main difference-in-difference results for this section, it is useful to begin our analysis by looking at the raw trends in the aggregated STI series for treated and untreated stations. This is done in Figure 4. The top panel shows average daily hospitalizations per 1,000 soldiers for primary syphilis sores in treated vs. non-treated stations in the U.K. before and after the CDAs came into operation. We can see that both treated and control locations had similar levels and trends in the period leading up to the introduction of the CDAs. Starting during the period in which the CDAs were introduced–between 1865 and 1870, indicated by the shaded region in the graph–the two groups of stations diverge and the treated stations show substantially lower rates of hospital admission rates. A similar pattern is visible in the middle graph, which focuses on daily admissions for secondary syphilis, a later stage of the disease that typically arrives several months after the primary syphilis sores disappear. The bottom graph shows the pattern for gonorrhea. For this disease, stations subject to the CDA had on average higher rates in the period before the CDAs came into operation. After the CDAs were operating, this difference disappears and the two groups exhibit similar rates of gonorrhea hospitalization. Thus, all three of these figures provide suggestive evidence that the introduction of the CDAs reduced STI rates in treated stations relative to those not treated.

For secondary syphilis, where we have data on rates by station and over time, Figure 5 presents the event study results generated by estimating equation (1) using the method in Callaway and Sant'Anna (2021). The results show that, in years prior to implementation of the acts, hospitalization rates were not trending differently in subjected and untreated stations. After implementation, hospital admissions begin to decline in subjected stations relative to the untreated. The divergence

[25] Specifically, our data come from the *Report from the Select Committee on the Contagious Disease Acts, 28 July 1881* p. 445-455. The data in the report distinguish between primary and secondary syphilis. These refer to the stage in the progression of the disease. Appendix B.2 provides additional details on the data.

[26] It appears that no similar data set was produced from Navy stations.

Figure 4: STI Hospitalizations at CDA vs. non-CDA Military Stations

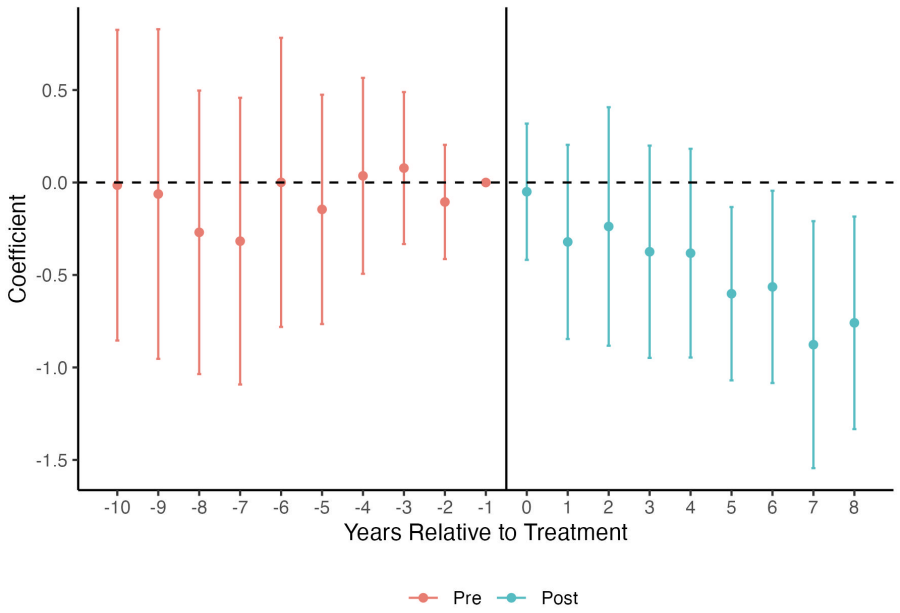


Note: Panel A shows the annual hospital admissions for primary syphilis per 1,000 soldiers. Panel B displays the daily average number of soldiers hospitalized for secondary syphilis per 1,000 soldiers. Panel C reports the annual hospital admissions for gonorrhea per 1,000 soldiers. All graphs report the aggregated values for subjected and untreated districts. The shaded region corresponds to the period in which the CDAs were being implemented (see Table B3). The data are from the *Report from the Select Committee on the Contagious Disease Acts, 28 July 1881* p. 445-455. Appendix B.2 provides additional details.

between treated and untreated stations builds over time, consistent with what we would expect given that (i) enforcement effectiveness improved during the first few years in which the Acts were enforced and (ii) reducing disease prevalence should have cumulative effects, since reducing infections in one year lowers the chance of further spread in the next year.

Appendix Table C3 column 1 presents the average of the dynamic treatment effects corresponding to the results in Figure 5. The estimate suggests the CDAs reduce the syphilis-related admissions rate by approximately 45% where the pre-treatment average annual admissions rate was approximately 30 hospitalizations per 1,000 soldiers. Table C3 also provides some additional robustness checks on these results. For example, we show that similar results are obtained if we use the hospitalization rate in levels rather than in logs as our outcome variable. We also show that similar results are obtained if we focus only on stations in England and Wales, a sample that corresponds more closely to the geographic area used in our other analysis.

Figure 5: The Effect of the CDAs on Hospital Admissions for Secondary Syphilis



Note: The figure shows the estimated coefficients and 95% confidence intervals for β_s in Eq. 1 estimated using the method from Callaway and Sant'Anna (2021) applied to the station-level hospitalization rate of soldiers from secondary syphilis. The x-axis is in event time relative to the year in which the CDAs became active in a district where the station was located. We estimate β_s for years in event time in which all treated stations have data available. The vertical line corresponds to the year of treatment. Standard errors are clustered at the station-level.

Summary: The results in this section indicate that the CDAs substantially reduced STI admissions rates among soldiers stationed in districts covered by the acts, relative to soldiers in stations where the CDAs did not apply. There are several mechanisms that likely contributed to this re-

duction. As we saw in the previous section, the size of the sex market fell after the CDAs were introduced. That alone likely reduced the rate of STI spread. In addition, because women showing symptoms of an STI infection were being quarantined, the risk of disease spread during any sex transaction was also likely to have been lower. Next, we look at whether similar reductions appear to have occurred among the general population.

4.2 The impact of the CDAs on general STI mortality

In this section, we examine how the CDAs changed STI rates among the general population. Direct measures of STI rates among the general population are not available in the historical setting that we study. However, we are able to observe mortality rates due to the most important STI, syphilis, at the county-level for all of England and Wales. These STI deaths are interesting in themselves, and they also reveal underlying patterns of STI presence. Note that, as we discuss in more detail below, most of these deaths likely occurred among infants who were infected at birth because their mothers were infected and then died soon after. This fact is relevant for our analysis because it means that deaths are likely to respond fairly rapidly to changes in the underlying disease environment.

Question: How did the CDAs affect STI mortality rates among the general population in locations subjected to the acts? Answering this question speaks to the broader impacts of the CDAs on STI spread as well as the impact that untreated STIs had on health during the period that we study. Given the previous results, we might expect to find that the CDAs reduced STI mortality as a result of a reduction in the number of sex transactions as well as a reduction in the chance that a women selling sex was currently infected with an STI. However, the direction of the effect is not certain ex ante. That is because, as we have seen, the CDAs also reduced the supply of sex available for purchase. This may have caused buyers to seek sex in other ways, either through consensual or non-consensual sex with women who were not sex workers.[27] If some of these buyers were infected with STIs, then this shift in their sexual habits may have increased the rate of STI spread among the broader population.

Data: The analysis in this section uses data on mortality due to STIs that we digitized from the Annual Reports of Births, Deaths, and Marriages produced by the Registrar General's office. By 1855, when our data begin, the Registrar General's office was overseeing an extensive network of local Registrars responsible for gathering comprehensive mortality statistics. Registrar General's reports, and particularly the mortality statistics, are generally regarded to be of very high quality.[28]

[27] Several studies have found that changing how the sex trade is regulated affects cases of sexual violence. Policies criminalizing the purchase of sex work have led to more reported cases of rape (Ciacci, 2023) whereas policies decriminalizing supplying sex work have reduced cases of sexual violence (Cunningham and Shah, 2017; Gao and Petrova, 2022). Bisschop et al. (2017) study a policy in the Netherlands that shares many features with the regulations in the CDAs in which sex workers are licensed and undergo health tests. They find that this licensing and testing regime reduces cases of rape. Motivated by these other studies we collected data on reported cases of rape and sexual assault against women from the *Judicial Statistics*, the same source we use to obtain data on the number of brothels used in section 3. In contrast to these other studies, we find no significant change in reported cases of sexual violence in response to the CDAs.

[28] Woods (2000) calls the mortality statistics the "shining start of Victorian civil registration."

However, it is important to note that challenges in diagnosing specific STIs mean that our syphilis mortality series likely includes deaths associated with other STIs as well, though most of these deaths were likely due to syphilis. We collect data from 1855 until 1906, allowing us to assess the existence of pre-trends for a decade before the CDAs were passed as well as two decades after the Acts were suspended. We end the sample in 1906 because that is the year the Wassermann test, the first diagnostic test for syphilis, was invented.

Our analysis uses data on syphilis deaths, which are reported annually for 45 counties in England and Wales. Syphilis deaths account for 3.6 out of every thousand deaths in England and Wales from 1860 to 1899, a total of 75,559 deaths. So, while syphilis was not a major cause of death, it was also not insignificant. Most of these deaths occurred among infants and young children. From 1860 to 1865, 70% of syphilis deaths occurred among children aged 0-1 and 76.7% were among children aged 0-5.

As placebos, we have also collected morality data on two other causes of death: cancer and deaths due to respiratory infections. The main causes of death in the latter category are bronchitis and pneumonia, while the category also includes deaths due to laryngitis, pleurisy, asthma, and some other more minor respiratory diseases (it does not include other major respiratory diseases such as tuberculosis). These placebos were chosen based on two main criteria. First, these represent two important causes of death that are unlikely to be affected in the short-run by a change in STI infection rates (which may influence mortality from some other causes through competing risks or comorbidities). Second, specifically for respiratory mortality, these causes of death are likely to be related to other potential confounding factors that we may be concerned about, such as poverty rates.

Analysis strategy and results: The structure of the STI mortality data allow us to use the same difference-in-difference empirical strategy described earlier where we estimate equation (1), but with some important differences. The most important difference is that we are able to look at effects in treated and control locations before the CDAs were passed, while the Acts were in operation, as well as after they were repealed. One common concern in difference-in-difference study designs is that the parallel trends assumption might be violated. A standard approach to guarding against this concern is to study pre-trends in the data. While parallel pre-trends do not guarantee that the treated units would have also experienced parallel trends during the treatment period in the absence of treatment, parallel pre-trends at least suggest that such a concern is unlikely. While our analysis passes this test, our setting allows us to go further. In particular, the off-on-off nature of the policy we study means that our results cannot be due to differential trends except in the highly unlikely case that those differential trends reversed at precisely the moment when the policy was repealed. Given what we know about the sources of the repeal, which occurred across all treated locations in the same year as a result of national agitation for women's rights, it seems extraordinarily unlikely that the identification assumptions could be violated in a way that reveals precisely the patterns we will find. A second advantage of being able to look before the CDAs came

into effect, while they were in force, and after they were repealed is that we are able to analyze whether any reductions in STI rates resulting from the regulations persist after the regulations are removed.

It is also useful to note that our unit of observation in this analysis is the county. We treat any county with a district subject to the CDAs in a particular year as treated. Counties are relatively large units; the whole of England and Wales are covered by just 45 counties. One benefit of running our analysis at the county level is that it will help us deal with concerns that our results may be driven by spillovers between treated districts and other nearby districts. Since most districts that are neighbors to treated districts will be in the same county, and most spillovers are likely to occur over relatively short distances, results obtained from a county-level analysis will likely capture both direct treatment effects as well as any spillovers to other nearby districts. However, evidence presented in Section 4.3 suggests that spillovers were not important in our setting.

Event study results obtained from applying the specification in equation (1) to the county-level syphilis mortality data are presented in Figure 6. As in the previous analysis, we deal with the fact that we have staggered treatment timing by using the estimation approach from Callaway and Sant'Anna (2021). A first feature to notice in these results is that there is no evidence that counties treated by the CDAs had differential trends in syphilis mortality in the years leading up to treatment. Next, notice how after treatment we see a relative decrease in syphilis mortality in counties subject to the CDAs.

The shaded rectangle in the graph indicates the period, in event time, corresponding to the suspension of the CDAs. Note that while suspension occurred in the same year (1883) for all locations, it shows up at a different point in event time for counties depending on when they were initially treated. To the right of the shaded rectangle we see another important finding. After that point, syphilis mortality in the treated counties begins to converge back toward zero. Within about six years, the difference relative to control counties becomes statistically insignificant. Furthermore, after two decades the coefficients have nearly converged back to no difference between treatment and control counties

Table 1 presents estimated average effects of the CDAs on the syphilis mortality rate in a variety of different specifications.[29] Across different specifications, the CDAs reduce the syphilis mortality rate by approximately 30%. Column 1 provides the baseline estimate where we restrict the analysis to the period up to 1883, when the CDAs were being actively enforced. Column 2 provides the estimate when using the full sample of data from 1855-1906 and corresponds to the average of the dynamic treatment effects from the event study in Figure 6. Column 3 includes London in the analysis. In Column 4, we look at the effect of the CDAs including only counties in the southern part of England. We do this because the CDAs were implemented only in districts in the south, which may mean that counties in the northern part of the England and Wales are not good control

[29]The reported coefficients correspond to the average of the dynamic treatment effect using the procedure in Callaway and Sant'Anna (2021).

counties, though this appears to be unlikely given that in the event study results from Figure 6 show that treated and control counties were trending similarly prior to implementation. When we restrict our analysis to the counties in the south eastern, south midland, and south western divisions of England and Wales, Column 4, the results are slightly smaller but still quite strong despite the fact that this specification restricts our sample to only 19 of 45 counties.

A different concern is that our results may be affected by spillovers to control counties if sex workers leave districts where the CDAs operated. As we have discussed, several factors suggest that such spillovers are unlikely.[30] Nevertheless, in Column 5 we estimate results excluding any county that borders on a CDA county and show that our results are largely unchanged.

Finally, in Columns 6 and 7, we estimate effects on two placebo causes of death, cancer and respiratory deaths. If our identification strategy is working well, then neither of these should be impacted by the introduction of the CDAs. Consistent with this expectation, the results show that there is no meaningful relationship between the CDAs and mortality due to these placebo causes of death. Full event study results for these placebos are available in Appendix Figure C3.

Summary: These results tell us that the CDAs led to a reduction in STI mortality in treated districts, and that this effect begins to reverse after the CDAs were repealed. The fact that we observe clear responses both to treatment and to the removal of treatment is notable, because it means that our results are extraordinarily unlikely to be due to differential underlying pre-trends.

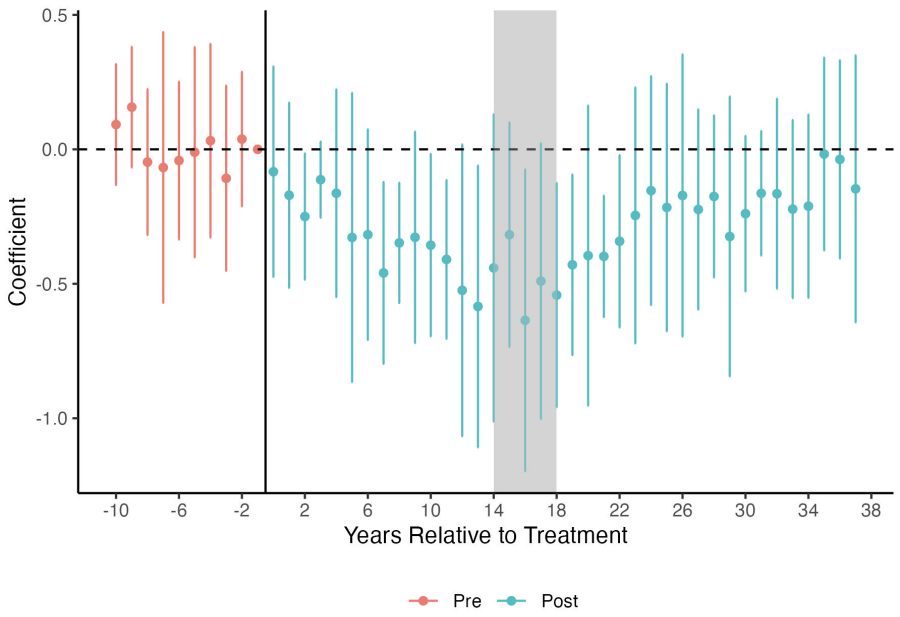
4.3 CDAs and childless couples

Question: Exposure to STIs comes with a risk of infertility, increased risk of miscarriage or stillbirth, and an increase chance of infant mortality. Several different STIs, including chlamydia and gonorrhea, when untreated, can lead to pelvic inflammatory disease resulting in infertility. STIs, particularly syphilis, can also increase the chances of miscarriages and stillbirths as well as mortality among infants that contract the disease from their mothers. Finally, STI infections may increase childlessness if they cause couples to have intercourse less frequently. There is some descriptive work in demographic history connecting STI prevalence in Britain historically to infertility (Szreter and Schürer, 2019). These medical facts, together with the changes to STI prevalence documented in previous sections, raise the following question: did the CDAs affect the prevalence of childless couples in treated districts?

Data: To analyze how the CDAs affected the rate of childless couples in treated locations, we turn to the census microdata for England and Wales. Using information on household structure included in the census, we identify all households with both a husband and wife present. We focus

[30]The historical accounts suggest the migration of sex workers during this period was local in nature. If job prospects were scarce in the countryside, women might move to a nearby town to practice sex work (Walkowitz, 1982). Furthermore, there is work by economic historians suggesting there was less geographic mobility in the UK relative to the US (Long and Ferrie, 2004). Finally, in the analysis in Section 4.3 we look at whether there is any evidence of cross-district spillovers within counties. The fact that we find no evidence of cross-district spillovers suggests that cross-county spillovers are even less likely to be an issue.

Figure 6: The Effect of the CDAs on Syphilis Mortality



Note: The figure shows the estimated coefficients and 95% confidence intervals for β_s in Eq. 1 estimated using the method from Callaway and Sant'Anna (2021) applied to the log county-level mortality rate from syphilis. The x-axis is in event time relative to the year in which the CDAs became active in any district within the county. We estimate β_s for years in event time in which all treated counties have data available. The vertical line corresponds to the year of treatment. The shaded region corresponds to the years in event time when the law was suspended. While suspension occurs in 1883 for all counties, this occurs in different years of event time because of staggered treatment timing. Standard errors are clustered at the county-level. London is excluded from the analysis.

Table 1: The Effect of the CDAs on County-Level Mortality Rates

	$\log(rate_{ct})$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ATT	-0.317	-0.293	-0.302	-0.247	-0.341	0.008	-0.030
	(0.076)	(0.104)	(0.062)	(0.119)	(0.087)	(0.053)	(0.043)
Observations	1232	2288	1260	504	896	903	1276
Specification	Pre-Suspension	Full Period	London	Southern	No Nearby	Cancer	Respiratory

Note: Each column provides the average of the dynamic treatment effects from estimating Eq. 1 using the method from Callaway and Sant'Anna (2021) for different types of mortality. In all specifications, the outcome is the log mortality rate, calculated as the number of deaths per 100,000 people. Data are annual at the county-level. The county of Greater London is excluded unless stated otherwise. The first column presents the results for syphilis restricting the sample prior to 1883 when the CDAs are suspended. The second column presents the results for syphilis using the full sample from 1855-1906. This specification corresponds to the event study in Figure 6. The third row presents the estimate when the Greater London county is added to the analysis and restricting to pre-suspension. The fourth column restricts the analysis to counties in the south-western, south midland, or south-eastern registration areas pre-suspension. The fifth column removes counties that border treated counties and restricts to pre-suspension. The sixth column presents the estimate for cancer mortality using data from 1860-1880. The seventh column presents the estimate for respiratory mortality using data from 1851-1880. Standard errors are clustered at the county-level.

on couples where the wife's age falls into a middle age range, since older couples are likely to have children who have left the home and younger couples may not have been married long enough to have conceived even if they are able (the census does not include information on the year that couples were married). In our main analysis, we use couples where the wife is between 25 and 40. In robustness exercises we extend this window out to age 45 and show that our results are not particularly sensitive to this choice. For each couple satisfying this criteria, we then count the number of children in the household and identify childless couples.

It is important to note that the unit of observation in this analysis is the district. This geographic unit is substantially smaller than the counties analyzed in the previous section; there are over 600 districts in England and Wales compared to just 45. This feature allows us to analyze spillovers from CDA districts into other nearby districts within the same county.

We draw our data from four census waves: 1851, 1861, 1891, and 1901. The first two provide pre-CDA observations, while 1891 and 1901 will reflect post-treatment outcomes. We do not consider the 1881 census because families in the age range we consider would have had some fertile years before the CDA and some years during the CDA, so that is not clearly either a pre-treatment or treatment observation (microdata for the 1871 census are not currently available to our knowledge). We exclude districts in the County of London from our preferred results, though we show that our findings are stronger when London is included.

Table 2 presents some basic statistics showing the rate of childless couples in the country as a whole as well as in the CDA and non-CDA districts and the difference between those two. In the first column, we can see that the rate of childless couples was high in 1851 and 1861, fell in 1891, and then increased again by 1901. There are two forces that can help explain this pattern. First, we know that health was improving in the second half of the nineteenth century, and that this improvement was particularly notable in terms of the reduction in child mortality (Woods et al., 1988). This trend, which begins in the 1860s, will tend to reduce the rate of childless couples. However, starting in 1877, fertility in Britain began to rapidly decline, a factor that will tend to increase the rate of childless couples, particularly by 1901 (Beach and Hanlon, 2023).

The statistics in Columns 2 and 3 show that CDA districts had higher rates of childless couples in the pre-CDA period. One explanation for this is the higher rate of STI prevalence in the CDA districts in the pre-treatment period. However, we also see that the gap between the rates in CDA and non-CDA districts falls sharply between 1861 and 1891, when the CDA was in operation. This pattern provides suggestive evidence consistent with a relative reduction in infertility, miscarriages, stillbirths, and infant/child mortality in CDA districts following the introduction of the CDAs.

Analysis strategy and results: We apply a difference-in-difference analysis strategy to study the impact of the CDAs on the rate of childless couples in a district. Our main regression specification is:

$$CHILDLESS_{it} = \beta(CDA_i * POST_t) + \gamma_i + \eta_t + \epsilon_{it} \tag{2}$$

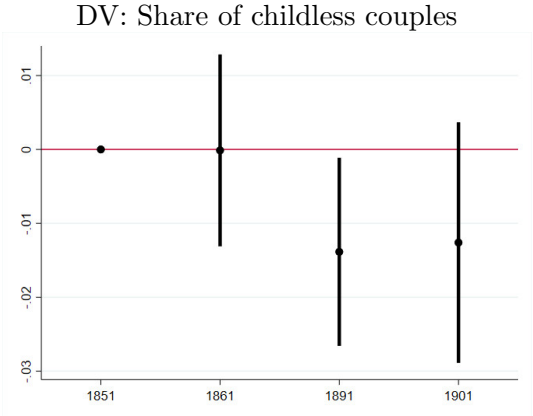
Table 2: Rates of Childless Couples with Wife Aged 25-40

Year	All districts	CDA districts	Non-CDA districts	Rate in CDA districts - rate in non-CDA districts
1851	0.159	0.188	0.158	0.03
1861	0.158	0.19	0.157	0.033
1891	0.143	0.167	0.143	0.025
1901	0.166	0.192	0.165	0.027

where $CHILDLESS_{it}$ is the share of childless couples in district i in census year t, CDA_i indicates CDA districts, $POST_t$ indicates post-CDA periods (1891 and 1901), and γ_i and η_t are district and time fixed effects. The advantage of this specification is that it is simple to estimate and easy to interpret. However, in the appendix we show that similar results are obtained from an alternative approach where regressions are run at the household level. We cluster standard errors by district to allow for serial correlation. In our main specification, we exclude London, though we also examine robustness to this choice.

Before we come to our main results, we present some event study results, in Figure 7, where in place of the $POST_t$ term in equation (2) we include a vector of year fixed effects, with 1851 as the excluded decade. We can see that there is no evidence of pre-trends from 1851-1861 and a clear reduction in the rate of childless couples in CDA districts in the post-CDA years.

Figure 7: The Effect of the CDAs on Childless Couples: Event Study Results



Note: The figure shows the estimated coefficients and 95% confidence intervals for coefficients estimated using Eq. 2 but replacing $POST_t$ with a set of year indicator variables. Data cover all couples in England and Wales where the wife's age at the time of the census is in [25-40]. N = 1,572. The unite of observation is the district-year and standard errors are clustered by district. The regression includes district and year fixed effects. Districts in the county of London are excluded from the analysis.

Table 3 presents our main results for childless couples. The simplest specification, in Column 1, shows that couples living in CDA districts were substantially less likely to be childless in 1891

Table 3: Analysis of the Effect of the CDAs on Childless Couples

Dep. Var.: Share of childless couples			
	(1)	(2)	(3)
CDA District	-0.0132***	-0.0161***	-0.0121**
x Post	(0.00486)	(0.00597)	(0.00538)
CDA County		0.00344	
x Post		(0.00400)	
District FE	Yes	Yes	Yes
Year FE	Yes	Yes	
County-year FE			Yes
Observations	1,572	1,572	1,568
R-squared	0.146	0.147	0.692

*** p<0.01, ** p<0.05, * p<0.1. Standard errors are clustered by district. Based on couples where the wife's age is between 25 and 40. London is excluded from the analysis. Based on specification in Eq. 2.

and 1901 than in the pre-CDA years (1851 and 1861). In Column 2, we look at whether there are any spillover effects on couples living in a county with a CDA district but not in the CDA district itself. We see no evidence of such spillover effects. In Column 3, we consider a more demanding specification that includes county-year fixed effects. Across all three results, we see a fairly consistent estimated decline in the rate of childless couples of 1.2-1.6 percentage points, equivalent to a decrease of around 6-9% in the rate of childlessness observed in the CDA districts in the pre-CDA period (see Table 2).

In Appendix Table C4 we consider the robustness of our results. In one set of robustness check we look at how our results change if we extend our sample to include couples where the wife's age was between 25 and 45. In a second set, we extend the geographic scope of the analysis to include London. Neither of these modifications has any meaningful impact on our results.

We can also generate similar results using households rather than districts as the unit of observation. Household-level results have the advantage that we can include some individual-level controls such as wife's and husband's age. However, those results use a linear probability model which relies on assumptions that may not be as valid. Household-level results, presented in Appendix Table C5 show that households living in CDA districts were less likely to be childless in the post-treatment years, though the results are only marginally statistically significant. Interestingly, we also find clear reductions in childlessness among couples where either the husband or the wife was born in a CDA county (district of birth is not observed), suggesting that couples were likely affected by whether they grew up in a treated location in the CDA or post-CDA period.

Summary: The results in this section show that couples who were exposed to the CDAs were less likely to be childless, a pattern that is consistent with what we would expect to observe in the presence of lower STI rates in CDA districts. This provides additional evidence that the CDAs improved public health, while also showing that those health improvements had meaningful impacts

on people's lives.

5 Repeal of the CDAs

Question: Why were the CDAs ultimately repealed despite the fact that–as we have shown–they were successful from a public health perspective? One potential answer to this question is that contemporary policymakers may have been unaware of the public health benefits of the acts. However, we know from historical evidence that this is not the explanation. While contemporaries did not have the statistical tools we have applied, the data available to them led a series of Parliamentary committees to conclude, correctly, that the acts were effective in reducing STIs among soldiers and sailors in the treated districts and likely brought health benefits to the broader population.[31] The fact that Parliament appeared to be aware of the public health benefits of the CDAs makes their repeal particularly puzzling. In the analysis below, we try to identify some of the key factors that contributed to this decision.

Background and data: Our analysis focuses mainly on the critical vote, on April 20, 1883, on a resolution condemning the compulsory inspection of sex workers under the CDAs. This was the pivotal vote in the elimination of the Acts. When the resolution passed, with a division of 182 MPs in support compared to 110 against, it effectively eliminated compulsory inspection, rendering the CDAs a dead letter.[32] Once compulsory examination was eliminated, it was only a matter of time until the full repeal of the CDAs. We also consider a second, unsuccessful, repeal vote that took place on May 21, 1873. This vote, which occurred as a consequence of rising resistance to the acts led by Josephine Butler and the LNA, represented the first major test of their popularity. Recall from Section 2.1 that the CDAs were enacted without a division in Parliament, so there are no votes from when the acts were passed for us to analyze.

The data we use, from Eggers and Spirling (2014), includes the votes of each MP who was present for each of these critical votes, as well as information such as their constituency, party affiliation, and age at the time of the vote. Using the constituencies, we identify MPs that represented locations subject to the CDAs. This will tell us something about how exposure to the CDAs and their consequences affected the opinions of MPs and their constituents.

We are particularly interested in how MPs votes on the CDA repeal were affected by their stance towards women's rights more generally. To measure this, we use their votes in other divisions on

[31] For example, the "Report from the Select Committee on Contagious Disease Acts" submitted on 7 August, 1882, after gathering hundreds of pages of evidence over several years of investigation, concluded that the acts reduced STI rates among soldiers. Beyond that, the committee reported that (p. xvii), "Your Committee have had evidence tending to show that the Acts have diminished venereal disease in the Civil Population of those areas of Great Britain where they have been in operation." The committee also noted (p. xviii) "the very general opinion of the medical profession, both inside and outside of the subjected districts, who on hygienic grounds strongly advocate the maintenance of the Acts." While these conclusions were disputed by opponents of the CDAs, they were consistent with the findings of other reports, such as the Parliamentary Committee of 1871.

[32] Note that the number of MPs that were present at the division is only a fraction of the 653 total MPs sitting in Parliament at this time. It was normal for many MPs to be absent for any particular debate, and in fact this was one of the best-attended divisions of the year.

issues related to women's rights occurring around the same time. For the 1883 analysis, we use votes on a resolution declaring that the franchise should be extended to women. For the 1873 analysis, we use votes in a series of divisions related to (1) married women's property laws and (2) the women's disability removal bill which aimed (unsuccessfully) to grant women voting rights.

We are also interested in measuring how MPs views on compulsory public health legislation affected their votes on the CDAs. Policies that involved government compulsion were controversial in Britain during the nineteenth century. This was a period when classical liberal ideas such as laissez-faire, were widely popular (Hanlon, 2024). At the same time, however, there was a strong public health movement that saw government action, including compulsory regulations, as absolutely necessary for improving health and welfare. In our analysis, we measure MPs views on the acceptability of compulsory public health legislation by looking at how MPs voted on an 1882 bill on compulsory vaccination, where the critical issue was whether government had the right to compel behavior that improved public health.

To obtain more exogenous variation in MPs attitudes towards women's rights, we have laboriously reconstructed MPs fertility history in order to identify their sons and daughters as of 1881. The MPs are a special population. Many are very wealthy and travel often, so they are often enumerated outside of their household during the census (or not enumerated at all, if they are abroad). Their children often attend boarding schools. MPs often have complex names which change over their lifetimes. Because of these features, reconstructing their fertility histories requires a labor-intensive manual review of all available information for each MP, including census records and other sources such as Burke's, the Oxford Dictionary of National Biography, and newspaper obituaries. We are able to identify the number of daughters and sons born to each MP as of the 1881 census for all but 35 out of the 294 MPs involved in the 1883 division.[33] Further details about the construction of these data, and some summary statistics, are available in Appendix B.5.

Analysis: As a starting point for our analysis, it is useful to note that neither of the critical votes on the CDAs broke down along party lines. While Conservatives tended to support retaining the CDAs and most Liberals were in favor of repeal, a substantial number of MPs split from the majority of their party in both the 1873 and 1883 votes. Table 4 describes the breakdown of votes by party. We can see that, in both votes, there was a non-trivial amount of crossover voting. We can also see that the share of voting MPs who were Liberals increased between 1873 and 1883, following the substantial Liberal victory in the 1880 election (note that it was common for many MPs to not be present for any particular vote, so the number of votes does not equal the number of MPs). However, the most notable change between the unsuccessful 1873 repeal vote and the successful 1883 vote was the shift in favor of repeal for MPs of every party. This shift in attitudes

[33]Most of those missing are Irish MPs. Those are more difficult to find because Irish census microdata is limited. Note that our procedure may miss some children, particularly those who died at a young age. However, infant deaths are likely to be much less common among MPs, who were essentially all wealthy relative to the general population. Moreover, there is no reason to expect that infant deaths varied depending on whether MPs were ultimately in favor or against the repeal of the CDAs, so these missing children are unlikely to be a source of bias.

Table 4: Votes for or against repeal by party

Party	1873 division			1883 division		
	Against repeal	For repeal	Share for repeal	Against repeal	For repeal	Share for repeal
Conservative	132	16	0.11	77	15	0.16
Liberal	97	104	0.52	21	147	0.88
Home Rule/Other	12	10	0.45	13	21	0.62
Total	241	130	0.35	111	183	0.62
Liberal share of voters		0.54			0.57	

appears to have been the critical factor in the defeat of the CDAs. If we hold support for repeal among MPs of each party at the 1873 levels but increase the share of Liberal Party voters as in the 1883 vote, that does not generate a majority in favor of repeal. In contrast, if we hold the shares of voters from each party at the 1873 levels but apply to them the share in favor of repeal for each party in the 1883 vote, that would generate a majority in favor of repeal.

To understand why attitudes about the CDAs might have changed, we analyze how different factors affected MP votes. Table 5 presents our results. The first two columns focus on the 1873 repeal vote while Columns 3-5 look at the 1883 vote. The first row of results shows that in both votes, Conservatives were more likely to vote against repeal. Interestingly, the second row of results shows that MPs from districts that were actually subject to the CDAs were strongly against repealing them. This is consistent with the MPs supporting the laws because of the public health benefits we documented in the previous section. In fact, this is one of the best predictors of MP support for the CDAs.

For the 1873 votes, we have two indicators for MP support for women's rights: their votes in divisions on the Married Women's Property Bill (MWP) and votes on the Women's Disability Removal Bill (WDB). The first of these, which allowed women to retain rights over their property after marriage, was ultimately successful, while the second, which would have given some women voting rights, was not. Supporters of either of those were substantially more likely to vote in favor of repealing the CDAs. For the 1883 vote, we have one indicator of MP support for women's rights: their vote on a resolution calling for women's suffrage in 1883. Again, we can see that supporters of women's rights were substantially more likely to favor repealing the CDAs in 1883. Note, however, that we cannot make any direct comparison between the magnitude of the coefficients on women's rights in the 1873 and 1883 votes, since they are measured using votes on substantially different types of resolutions. At the bottom of Column 5, we also examine whether MP votes on another measure in which the state compelled individuals to take actions to improve public health, in this case vaccination, can predict votes on the CDAs. While we can only analyze this for a smaller set of MPs, the results do not indicate that support for state compulsion in order to improve public

Table 5: Analysis of MP votes on resolutions against the CDAs

	DV: MP vote in favor of repealing the CDAs				
	1873 resolution		1883 resolution		
	(1)	(2)	(3)	(4)	(5)
Conservative	-0.241***	-0.229***	-0.430***	-0.416***	-0.432*
	(0.0685)	(0.0693)	(0.105)	(0.105)	(0.236)
CDA district	-0.412***	-0.409***	-0.486***	-0.481***	
	(0.0792)	(0.0844)	(0.107)	(0.108)	
MWP supporter	0.176**	0.195***			
	(0.0724)	(0.0736)			
WDB supporter	0.216***	0.213***			
	(0.0642)	(0.0642)			
Suffrage supporter			0.316***	0.318***	0.460***
			(0.0897)	(0.0892)	(0.149)
MP age		-0.00293		0.00444*	0.00819*
		(0.00239)		(0.00252)	(0.00430)
Compulsion supporter					-0.140
					(0.117)
Observations	241	240	129	129	49
R-squared	0.231	0.235	0.404	0.415	0.415

Linear probability regressions with robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

health was a strong predictor of support for the CDAs. To summarize, we find MPs who were most exposed to the public health benefits of the CDAs were more likely to support them, while those who were stronger supporters of women's rights opposed them.

While the correlation between CDA votes and votes on other legislation related to women's rights described in Table 5 suggest that those issues are likely to be closely connected, we want to generate more causal evidence that concern for women affected MPs votes. To do so, we follow Washington (2008) and consider the role of having daughters versus sons on MP's attitudes towards women's rights. The basic assumption in this approach is that, while MPs could make decisions about the number of children that they had, whether they had sons or daughters was effectively random. Given that sex-selective abortion or infanticide was not practiced in our setting, and that the population we study was quite wealthy (so daughters were unlikely to die at higher rates due to lack of resources) this assumption seems reasonable.[34]

As noted in recent literature building on Washington (Costa et al., 2019; Green et al., 2023; Van Effenterre, 2020), the influence of daughters may be context dependent. So, the first step in this analysis is to establish that having daughters influenced MP attitudes towards women's rights in the context that we study. Columns 1-2 of Table 6 look at how having daughters or sons affects MP votes on the 1883 resolution in favor of women's suffrage. Column 1 tells us that having any daughter substantially increases the probability that an MP supports women's suffrage,

[34]In fact, our data show quite balanced sex ratios. The 259 MPs in our data had 446 daughters and 421 sons by 1881 according to our reconstructed fertility histories.

while having sons reduces the probability. The cleanest variation in this specification comes from comparing the difference in the daughter and son coefficients, which deals with the fact that MPs with children may be systematically different than those without them. An F-test, shown at the bottom of the table, shows that there are strong differences between the daughter and son effects in Column 1. Column 2 looks at whether the number of daughters or number of sons matters. Here we do not see statistically significant effects, though the basic pattern is consistent with more daughters increasing support for women's suffrage, while more sons decreases support. Thus, it appears that what matters is having a daughter at all, rather than the number of daughters someone has. To summarize, the results in Columns 1-2 of Table 6 establish that in our context having a daughter rather than a son influences MPs attitudes towards women's rights.

In Columns 3-5, we look at how having daughters versus sons affects votes on the 1883 resolution against compulsory inspection under the CDAs. In Columns 3 and 4, we see clear evidence that having daughters makes MPs more likely to vote against the CDAs, while the effect of sons is the opposite. A test of the difference between having any daughters and having any sons, at the bottom of Column 3, shows that those effects are statistically distinguishable at the 5% level. As in the case of women's suffrage, it appears that having any daughter is more important than the number of daughters. In Column 5, we look at whether the effect of daughters differs for Conservative MPs relative to other (mostly Liberal) MPs. We find that effect of daughters is not substantially different for MPs from different parties. Overall, these results provide more causal evidence that concerns about women's rights affected the attitudes of MPs towards the CDAs.

How pivotal was support for women's rights in the passage of the 1883 resolution? To provide a back-of-the-envelope answer to this question, we use the estimates from Columns 4-5 of Table 5, which suggests that supporting women's suffrage increased the probability that an MP voted against the CDAs by about thirty percent. So, given that 62% of Liberal MPs voted in favor of suffrage, we could potentially attribute around 31 out of 147 Liberal votes against the CDAs to support for women's rights. Applying the same methodology to each party, and then removing this effect from the observed votes, we estimate that without the support for women's rights the resolution against the CDA would have failed by a vote of around 154 to 140. While this is only a rough calculation, it suggests that support for women's rights was likely a pivotal factor in the passage of the resolution against the CDAs.

The role of women's rights suggested by the statistical results above comes through clearly in the debate that preceded the 1883 vote. For example, George Osborne Morgan, Liberal MP for Denbighshire and a member of the select committee that studied the CDAs, who was a supporter of the acts put it this way: "Another objection often raised against them is this–it is said that they operate unfairly, inasmuch as they are applied to women and not to men. I confess I do not understand the argument. The Acts are directed not against women, but against prostitutes..."[35]

[35] *Hansard*, 20 April 1883.

Table 6: Influence of daughters on suffrage and CDA votes

	DV: MP vote in favor of women's suffrage		**DV: MP vote against the CDAs**		
	(1)	(2)	(3)	(4)	(5)
Any daughter	0.260**		0.127**		0.139**
	(0.101)		(0.0533)		(0.0636)
Any son	-0.297***		-0.0595		-0.0592
	(0.0972)		(0.0571)		(0.0574)
Num. daughters		0.0174		0.0288*	
		(0.0247)		(0.0147)	
Num. sons		-0.0331		-0.00883	
		(0.0263)		(0.0142)	
Conservative	-0.443***	-0.441***	-0.673***	-0.671***	-0.648***
	(0.0797)	(0.0847)	(0.0518)	(0.0517)	(0.0808)
MP age	0.00130	0.00108	0.00380*	0.00356*	0.00368*
	(0.00328)	(0.00352)	(0.00194)	(0.00198)	(0.00196)
CDA district			-0.190***	-0.189***	-0.185***
			(0.0475)	(0.0485)	(0.0510)
Any daughter * Conservative					-0.0388
					(0.101)
Observations	129	129	259	259	259
R-squared	0.245	0.190	0.469	0.468	0.469
	Test that daughter effect equals son effect				
F-stat	10.32	1.37	3.97	2.53	3.92
p-value	0.0017	0.2437	0.0474	0.1133	0.0489

Linear probability regressions with robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

George Russell, Liberal MP for Aylesbury who opposed the CDAs, responded that the acts were:[36]

> "fundamentally immoral. The first respect in which they offend the moral sense is their miserable injustice as between man and woman. The whole view of life and society upon which this wretched legislation rests loses sight of the fact that impurity is as infamous in a man as in a woman. It may be said, in too many cases, that it is more heinous in man. The woman may be reduced to it by the bitter necessity of living; but the man reduces himself to it in obedience to a selfish lust. The guilt being equal between the two sexes, how differently are they treated. The man suffers no loss of position, no interference with the ordinary comforts of his life; it is not even a bar to a respectable marriage. But how different the lot of the woman!

6 Conclusions

One lesson from our results is that, when well-designed and effectively enforced, regulation of the sex trade can lead to substantial reductions in STI spread relative to a laissez-faire regime. This is true even in an environment in which STI treatment is ineffective. Of course, this does not mean that the policy we study improved welfare, since it also had other consequences not captured here. However, from a public health perspective the CDAs were clearly effective.

A second lesson from our study, however, is that even when a public health policy is effective at achieving its primary aim–in this case reducing the spread of STIs–it may ultimately fail as a policy if the burden of regulation is widely viewed as unfairly distributed. In the case that we study, despite the success of the Contagious Disease Acts as public health measures, the acts were ultimately repealed because they were viewed as a discriminatory infringement on the liberty of women.

These findings have obvious implications for current health policy debates, ranging from those over the legalization of the sale of sex to controversy about Covid lockdowns and vaccine mandates. Our findings suggest that the ultimate success of any public health intervention will depend not only on the policy's effectiveness, but also the percieved fairness of the distribution of the costs of the intervention. The experience of the CDAs demonstrates that public health interventions that place too much of the burden on one group, even when that group is disempowered, risk igniting public resistance and ultimately facing repeal. This means that the most effective public health policy designs need to balance the effectiveness of the intervention at reducing the spread of disease or improving health with the size and distribution of the costs imposed.

[36] *Hansard*, 20 April 1883.

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Appendix

A Empirical setting appendix

A.1 LNA protest of 1870

Below is the text of the protest published by the LNA in the *Daily News* at the end of 1869, as quoted from Butler (1909), p. 44. Butler claims that 120 names were attached to the original protest but that the number of signatories eventually reached over two thousand, including many notable women such as Harriet Martineau and Florence Nightingale.

We, the undersigned, enter our solemn protest against the Acts.

(1) Because, involving as they do such a momentous change in the legal safeguards hitherto enjoyed by women in common with men, they have been passed not only without the knowledge of the country, but unknown in great measure to Parliament itself; and we hold that neither the Representatives of the People nor the Press fulfill the duties which are expected of them when they allow such legislation to take place without the fullest discussion.

(2) Because, so far as women are concerned, they remove every guarantee of personal security which the law has established and held sacred, and put their reputation, their freedom, and their person absolutely in the power of the police.

(3) Because the law is bound, in any country professing to give civil liberty to its subjects, to define clearly an offence which it punishes.

(4) Because it is unjust to punish the sex who are the victims of a vice, and leave unpunished the sex who are the main cause both of the vice and its dreaded consequences; and we consider that liability to arrest, forced medical treatment, and (where this is resisted) imprisonment with hard labour, to which these Acts subject women, are punishments of the most degrading kind.

(5) Because by such a system the path of evil is made more easy to our sons, and to the whole of the youth of England, inasmuch as a moral restraint is withdrawn the moment the State recognises, and provides convenience for, the practice of a vice which it thereby declares to be necessary and venial.

(6) Because these measures are cruel to the women who come under their action–violating the feelings of those whose sense of shame is not wholly lost, and further brutalising even the most abandoned.

(7) Because the disease which these Acts seek to remove has never been removed by any such legislation. The advocates of the system have utterly failed to show, by statistics or otherwise, that these regulations have in any case, after several years' trial, and when applied to one sex only, diminished disease, reclaimed the fallen, or improved the general mortality of the country. WE have on the contrary the strongest evidence to show that in Paris and other continental cities, where women have long been outraged by this system, the public health and morals are worse than at home.

(8) Because the conditions of this disease in the first instance are moral not physical. The moral evil, through which the disease makes its way, separates the case entirely from that of the plague, or rather [sic] scourges, which have been placed under police control or sanitary care. We hold that we are bound, before rushing into experiments of legalising a revolting vice, to try to deal with the causes of the evil, and we dare to believe, that with wiser teaching and more capable legislation, those causes would not be beyond control.

B Data appendix

B.1 Locations covered by the CDAs

Table B1 describes the locations included in the CDAs, including details on the Act in which the location was included and the year in which enforcement actually began. Note that there may be some delay between when the Act was passed covering a location and when enforcement began. This delay was due to the need in some locations to expand hospital facilities to accommodate women who were being isolated.

The last two columns indicate whether the location is included as part of either the station-level anlaysis, in Section 4.1, or the county or district level analyses in Sections 3, 4.2, and 4.3. Note that the station-level analysis includes only locations with an Army barracks (no data were provided for hospitalizations at Navy stations) and the district and county-level analyses use data that is only available for England and Wales.

Table B1: Locations covered by the CDAs

Location	**Country**	**Primary service**	**Authorizing act year**	**Enforcement begins**	**In stations analysis** (Army only)	**In district or county-level analysis** (Eng./Wales only)
Portsmouth	England	Both	1864	1864	Yes	Yes
Plymouth/Devonport	England	Both	1864	1865	Yes	Yes
Woolwich	England	Army	1864	1866	Yes	Yes
Greenwich***	England	Navy	1864	1870	Yes	Yes
Chatham	England	Both	1864	1865	Yes	Yes
Sheerness	England	Navy	1864	1865	Yes	Yes**
Deal****	England	Both	1864	1870	Yes	Yes
Aldershot	England	Army	1864	1867	Yes	Yes
Colchester	England	Army	1864	1869	Yes	Yes
Shorncliffe	England	Army	1864	1868	Yes	Yes
The Curragh	Ireland	Army	1864	1870	Yes	
Cork	Ireland	Army	1864	1870	Yes	
Queenstown	Ireland	Navy	1864	?		
Windsor	England	Army	1866	1868	No*	Yes
Canterbury	England	Army	1869	1870	Yes	Yes
Dover	England	Both	1869	1870	Yes	Yes
Gravesend	England	Navy	1869	1870		Yes
Maidstone	England	Army	1869	1870	Yes	Yes
Southampton	England	Navy	1869	1870		Yes
Winchester	England	Army	1869	1870	Yes	Yes

*Windsor is an army station but it is excluded from the station-level analysis because of missing data. ** Sheerness is included in the station-level analysis because it is grouped with Chatham, which included an Army garrison. *** Greenwich is not listed as a separate location in the acts, but part of the district is included under Woolwhich. However, enforcement in Greenwhich began later than in Woolwich. **** Deal was not listed separately in the acts, but was included as part of Sheerness.

B.2 Data appendix for the station-level analysis

This appendix provides more details on the data used in the station-level analysis of STI hospitalization rates presented in Section 4.1.

Data: To assess how STI transmission changed after the CDAs were implemented, we use data on the number of hospital admissions of British soldiers due to various STIs. The data we use is contained in the *Report from the Select Committee on the Contagious Diseases Acts* published in 1881. This document contains the minutes of the Committee as they interviewed health and government officials in favor of the CDAs as well as opponents of the laws. A medical official, Inspector General Lawson, was called before the committee to provide statistics in defense of the Acts. Lawson compiled data on hospital admissions of British soldiers at stations subjected to the CDAs and those that were untreated. We digitize these statistics which are located on pages 445-455 of the report.

For hospital admissions due to gonorrhea and primary syphilis, Lawson only reported the data aggregated across all treated and untreated stations in the United Kingdom. Therefore, for these outcomes we cannot conduct a conventional difference-in-differences analysis.

However, Lawson provides station-level data for secondary syphilis hospital admissions from 1860-1878 for each station in England, Wales, Scotland, Northern Ireland, and Ireland averaging at least 500 soldiers annually. This yields an annual panel with fourteen stations in subjected districts and thirteen stations not under the CDAs. Table B2 presents the stations in the data presented by Lawson as well as the country it is located in as well as its treatment status.

The following list provides the specific data within the report used in our analysis.

- Figure 4A: annual primary syphilis hospitalizations per 1,000 soldiers is taken from Table 1 (page 445).
- Figure 4B: the number of soldiers in the hospital daily for secondary syphilis per 1,000 soldiers is taken from Table 2 (page 446).
- Figure 4C: annual gonorrhea hospitalizations per 1,000 soldiers is taken from Table 1 (page 445).
- Figure 5: the station-level secondary syphilis data used in the event study analysis are taken from Appendix No.5 (pages 454-455).

Defining treatment status: Table B2 describes the set of stations used in the analysis. This includes all of the stations for which complete data are available over the analysis period. Note that this is not a complete list of locations subject to the CDAs, since some locations with Navy stations were also subject to the CDAs but do not appear in the hospitalization analysis, which is based on Army data only. Figure B1 shows the locations of these stations.

Table B2: The List of Military Stations in the Analysis of Hospital Admissions for Syphilis

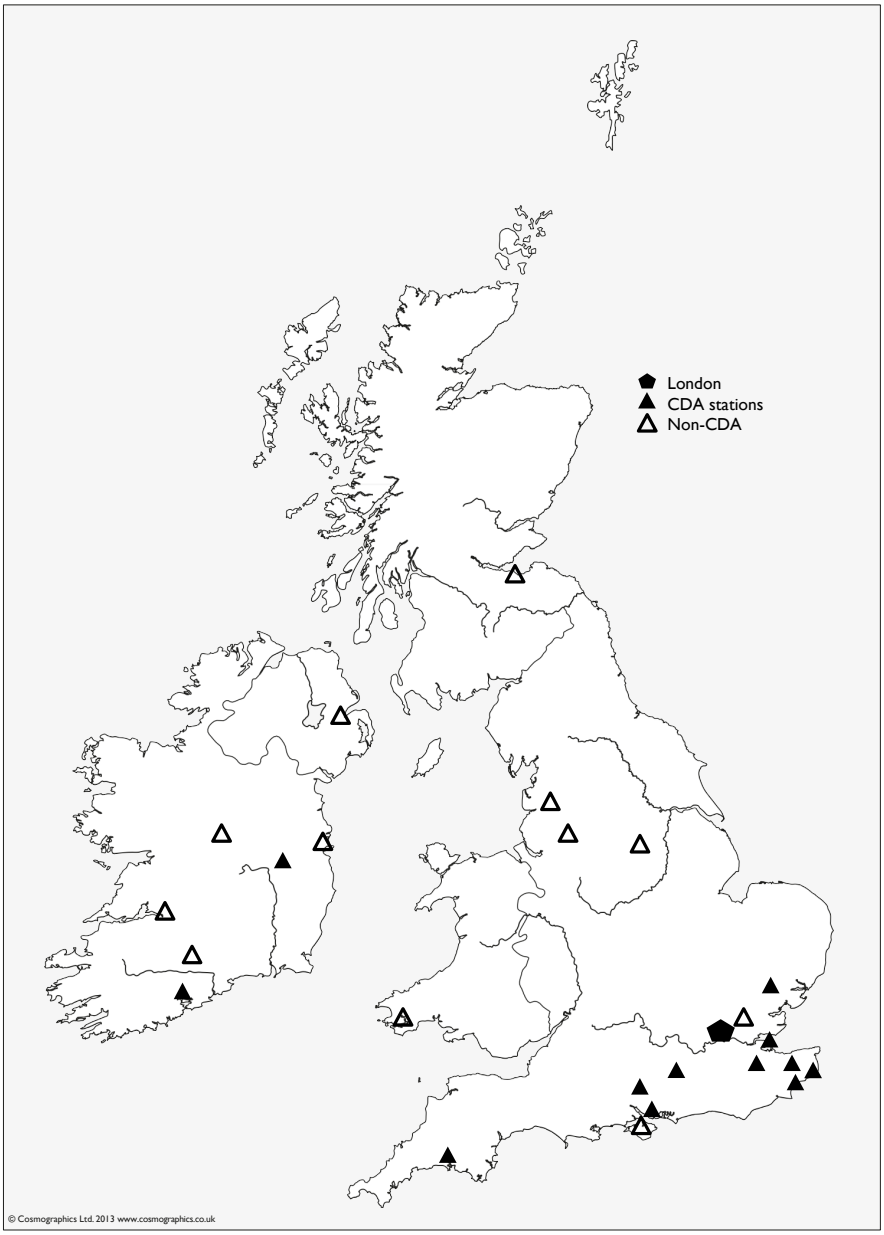
Station	Country	Subjected	Treatment Year
Athlone	Ireland	No	
Belfast	Northern Ireland	No	
Dublin	Ireland	No	
Edinburgh	Scotland	No	
Fermoy	Ireland	No	
Hounslow	England	No	
Isle of Wight	England	No	
Limerick	Ireland	No	
Manchester	England	No	
Pembroke Dock	Wales	No	
Preston	England	No	
Sheffield	England	No	
Aldershot	England	Yes	1867
Canterbury	England	Yes	1870
Chatham & Sheerness	England	Yes	1865
Colchester	England	Yes	1869
Cork	Ireland	Yes	1870
Curragh	Ireland	Yes	1870
Devonport & Plymouth	England	Yes	1865
Dover	England	Yes	1870
Maidstone	England	Yes	1870
Portsmouth	England	Yes	1864
Shorncliffe	England	Yes	1868
Winchester	England	Yes	1870
Woolwich	England	Yes	1866

B.3 Treatment in the county-level analysis

This appendix provides more detail on how treatment status was assigned in the county-level analysis of brothels in Section 3 and of STI mortality in Section 4.2 as well as the district-level analysis of childless couples in Section 4.3. Note that all of these analysis focus on England and Wales exclusively, because the outcome data are not available for Scotland or Ireland.

The timing of when districts were subjected to the CDAs was taken from the *Annual Report of the Assistant Commissioner of the Police of the Metropolis Relating to the Contagious Diseases Acts* in 1881. Table B3 shows names of the treated districts as well as the dates the CDAs began operation. As amendments to the 1864 CDA were passed in 1866 and 1869, additional districts were subjected to the laws. In total, fifteen locations were treated between 1864 and 1870. For analysis conducted at the county level, Table B3 shows the counties where the subjected districts are located. In this context, a county is defined as treated in the first year the CDAs begin to

Figure B1: Map of military stations included in the analysis in Section 4.1



Note: London is included in this figure as a point of reference, but the London station is not included in the analysis because syphilis cases at London were pooled with cases at Windsor for the first few years of the analysis. However, Houndslow, on the outskirts of London, is included in the analysis.

operate in one of its districts.

Table B3: Timing of When Districts Became Subjected to the CDAs

Subjected District	Date of Operation	County
Portsmouth	1864-12-03	Hampshire
Plymouth/Devonport	1865-04-01	Devonshire
Sheerness	1865-06-09	Kent
Chatham	1865-06-12	Kent
Woolwich	1866-11-14	Greater London
Aldershot	1867-04-12	Hampshire
Windsor	1868-04-01	Berkshire
Shorncliffe	1868-07-27	Kent
Colchester	1869-01-27	Essex
Greenwich	1870-01-06	Greater London
Winchester	1870-01-06	Hampshire
Dover	1870-01-19	Kent
Canterbury	1870-01-21	Kent
Deal	1870-02-05	Kent
Maidstone	1870-02-15	Kent
Gravesend	1870-02-17	Kent
Southampton	1870-05-27	Hampshire

Figure B2 shows CDA districts and CDA counties in England and Wales.

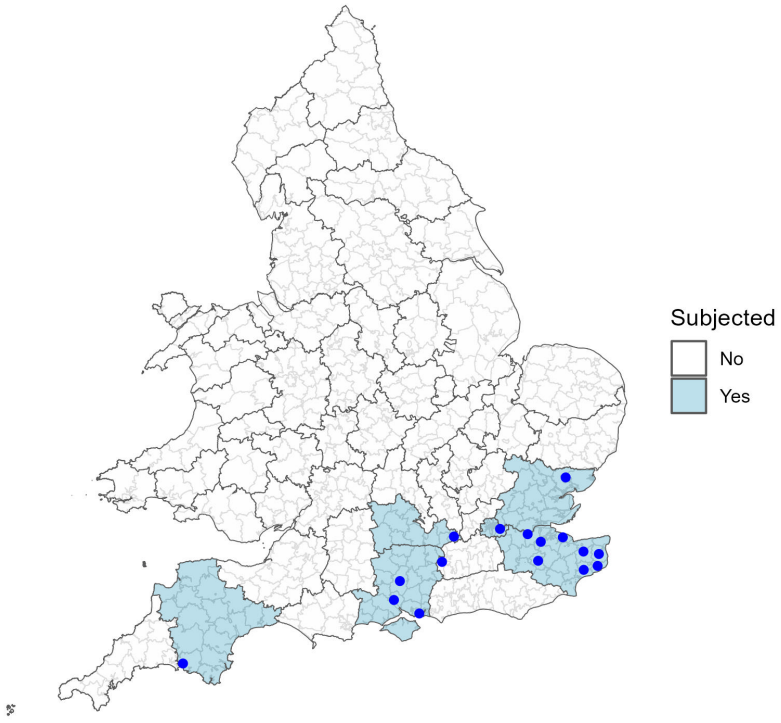
B.4 Police data

The Parliamentary Papers contain the detailed records officials kept on how the CDAs operated in subjected districts. We digitize parts of the *Annual Report of the Assistant Commissioner of the Police of the Metropolis Relating to the Contagious Diseases Acts* in 1881. This report contains information related to the total number of registered sex workers, their ages, the establishments where the sex trade took place, information on the examinations and hospitalization of sex workers, and reasons why women exited the industry. Information is reported for each of the seventeen subjected districts from the first year of treatment through 1880.

The following list provides the specific tables and variables within the report that are used to produce the Figures in the paper. Throughout the list we abbreviate columns, for example, when referring to column 22 we report `c22`.

- Figure 1A: total medical inspections is taken from Table 1, `c22`.
- Figure 1B: inspections per sex worker is defined as total inspections per the number of women that attended for examination from Table 1 (`c17/c22`).
- Figure 2A: total registered sex workers is taken from Table 2, `c13`.

Figure B2: Map of Counties & Districts Subjected to the CDAs



Note: The figure shows the locations where the CDAs were implemented. The darker boundaries are the counties in England and Wales. The lighter boundaries are districts (the level of treatment assignment). The dots correspond to the treated districts that are subjected to the CDAs. The shaded counties are the six counties that contain treated districts. Data on the treated districts are from the *Annual Report of the Assistant Commissioner of the Police of the Metropolis Relating to the Contagious Diseases Acts* in 1881. Appendix A provides additional details (see Table B3).

- Figure 2B: the total number of establishments hosting the sex trade is taken from Table 3, `c15`.

- Table C1: the data on district-level total registered sex workers is taken from Table 2 in the report, `c13`.

- Figure C1: the age distribution of registered sex workers is taken from Table 2 (`c1 to c12`).

B.5 MP fertility history data

In section 5, we use variation in whether MPs had daughters or sons to generate plausibly exogenous variation in their attitudes towards women's rights. In this appendix, we describe the process through which we reconstructed the MPs fertility histories. At the end, we provide some basic descriptive statistics on the fertility data.

The starting point for this process is the MP data compiled by Eggers and Spirling (2014) which includes MP names and, conveniently, their year of birth. For every MP, we also begin by pulling their Wikipedia page. Those exist, at varying lengths, for every MP in our set. While we find evidence of substantial inaccuracies in the Wikipedia pages, they do provide useful information. In particular, they almost always provide a wife's name if the MP was married (many MPs were also married multiple times, almost always because their wife died). In some cases the Wikipedia pages also provide information on children, but as we have found that information to be inaccurate in many cases, we use it only when it can be verified from other sources. In addition, we often use information from entries in the Oxford Dictionary of National Biography, and in rarer cases, from Burke's or Debret's (which compile information on the aristocracy). We also use obituaries from the Times of London, though during this period those rarely mention children.

The main source that we use is the census microdata, accessed through Ancestry.com. For each MP, we begin by pulling the 1881 and 1871 census sheets, and then when more information is needed we search in the 1851, 1861, 1891, and 1901 censuses. In addition, once we know the MPs wife's name we may search for her separately. In some cases we will also search for children in order to verify information obtained from other sources.

To illustrate some of the issues that make this process challenging, here we will describe an example for one MP, Mr George Augustus Frederick Cavendish-Bentinck, who we know from the Eggers and Spirling data was born in 1821. Like many MPs, this one has a complicated name. In Wikipedia, he appears as George Cavendish-Bentink, and the Wikipedia entry is unusually thorough. It suggests that he had two daughters and two sons, and was married to Prudence P.

After searching for a few name combinations in the Census, we find him listed as George A. F. C. Bentinck in the 1881 census (he appears as George Cavendish-Bentinck in Wikipedia). In that census, he is enumerated on Grafton St. in London with two sons, William G.C. Bentinck (age 27) and William G.F.C. Bentinck (age 24) plus a grandson and more than a dozen servants. Finding

adult children in the household is extremely common among the population we are looking at. This is a useful feature, because it means that we can often identify children in later censuses.

In the 1871 Census, we find George enumerated with his wife Prudence P.C. Bentinck, one daughter, Jessica C. Bentinck (age 18 in 1871) and William J F Bentinck (age 14). From his age and name we can conjecture that the latter is the William G.F.C. Bentinck enumerated in the 1881 census.

We cannot located George in the 1861 census, though he does appear in the 1851 census (aged 29) enumerated with his wife Prudence and no children. If we stopped here, we might conclude that Bentinck had two sons and one daughter, though Wikipedia suggests that he in fact had two daughters.

We can, however, make further progress by searching for his wife in the Census, particularly since, having already found her once, we know here birth year and she has a less common name. In the 1861 Census, we find Prudence enumerated in London, without George, but with a daughter, Christina (age 8) and two sons, George William (age 7) and Frederick G.W. (age 4). The sons are evidently those enumerated later, but with the ordering of their names switched. This switching is actually common; it probably results from the fact that they went by their second name since, at least according to Wikipedia, the sons shared William as a first name. The daughter is in fact the Jessica, aged 18, enumerated in the 1871 census. Her name has also been switched; in fact her name was Christina Anne Jessica Cavendish-Bentinck according to Wikipedia. Still, we are short one daughter. Also, it is unclear where George was in 1861. Perhaps he was out of the country.

However, Prudence appears again, as Prudence P Cavendish Bentinck, in the 1891 Census, though George died just before that census was taken. She is listed as a mother-in-law in the household of John Arthur James and his wife Mary V. James, age 29. This is the missing daughter, who is listed in George's Wikipedia page as Mary Venetia Cavendish Bentinck, born in 1861.

At this point, we stop our search and enter the following data for George Bentinck: 2 daughters and 2 sons born by 1881. However, it is interesting to ask: what happened to Mary V. in the earlier censuses, particularly 1871, when she would have been just 9 years old and we would have expected her to be living at home? Since we have her maiden name, we can answer this question easily. She appears in the 1871 census as a visitor in the household of Thomas Whichcote, a "Baronet and Landowner Farming 935 Acres" according to his census occupation. Perhaps Mary was friends with Whichcote's daughter Isabella, who was just a couple of years older than her. In any case, she probably had a comfortable visit given that 17 servants were also enumerated in Whichcote's household.

This example illustrates many of the issues that we run into in trying to reconstruct the fertility histories of MPs. It also shows why we have adopted a labor-intensive manual approach, and why we have confined our analysis to the 1883 vote alone. Not all MPs are so complicated, but many are. For a small fraction, it is completely impossible to reconstruct their fertility histories. This is usually either because they happen to have a particularly common name, or because they were

Table B4: Fertility data summary statistics

	Number	Share
MPs in the 1883 division:	294	
MPs with fertility histories:	259	0.88
Of those...		
MPs with children:	188	0.73
Number with any daughters:	160	0.62
Number with any sons:	165	0.64
Total number of children:	867	
Of those...		
Number of daughters:	446	0.51
Number of sons:	421	0.49
Avg. number of children for those with any:		4.61

an Irish MP and therefore were unlikely to appear in the available English, Welsh, and Scottish census data.

Table B4 presents some basic statistics based on the reconstructed fertility histories. The top two lines show that we were able to reconstruct fertility histories for around 88% of the MPs who were present for the 1883 division on the CDAs. Of those, around 73% had any children, with roughly equal numbers having daughters and sons. Note that some MPs were young and would go on to have many children later, though many had completed fertility. A number of MPs were also life-long bachelors or had marriages that produced no children. In total, these MPs had 867 children by 1881, around half of which (51%) were daughters.

C Results appendix

This section provides additional results supporting the findings presented in the main text.

C.1 Appendix to the analysis of the police data

Here we present some additional results on the impact of the CDAs on the market for sex. We begin with some additional descriptive data.

Table C1: Total Supply of Sex Workers Over Time by District

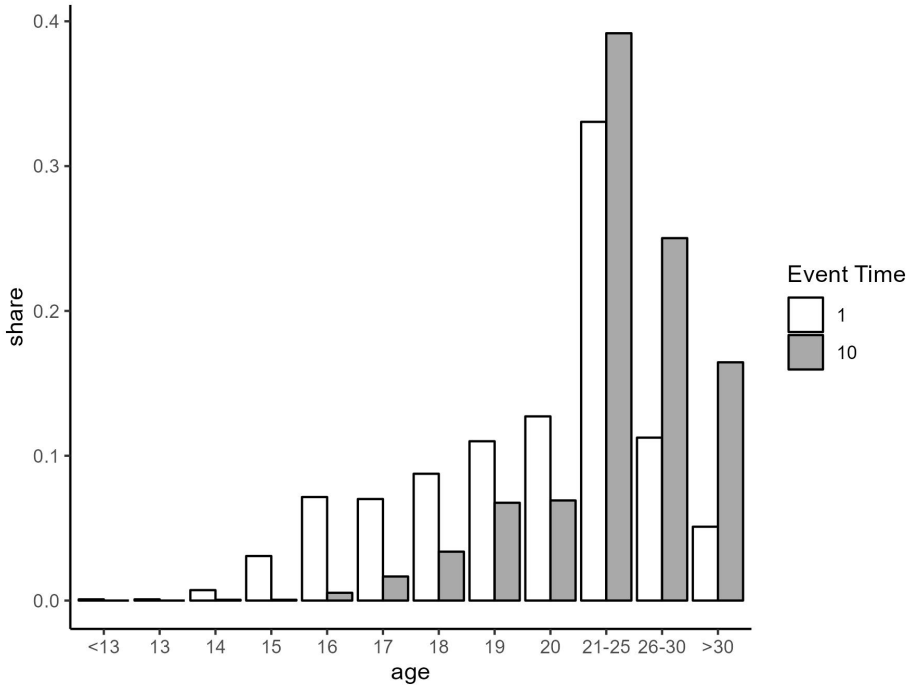
	Total Sex Workers			Percent Change	
District	$t = 0$	$t = 5$	$t = 10$	5 Years	10 Years
Aldershot	266	235	154	-11.7	-42.1
Canterbury	42	36	44	-14.3	4.8
Chatham	220	281	175	27.7	-20.5
Colchester	158	37	31	-76.6	-80.4
Deal	26	13	9	-50.0	-65.4
Plymouth/Devonport	1,770	557	442	-68.5	-75.0
Dover	92	50	34	-45.7	-63.0
Gravesend	47	33	30	-29.8	-36.2
Greenwich	151	74	98	-51.0	-35.1
Maidstone	58	19	21	-67.2	-63.8
Portsmouth	1,355	590	494	-56.5	-63.5
Sheerness	73	59	33	-19.2	-54.8
Shorncliffe	70	38	21	-45.7	-70
Southampton	154	139	104	-9.7	-32.5
Winchester	76	23	12	-69.7	-84.2
Windsor	54	24	12	-55.6	-77.8
Woolwich	240	200	152	-16.7	-36.7

Note: The table provides the supply of sex workers for each of the 17 treated locations. Columns two through four show the total registered sex workers for the year the district was treated, after 5 years, and after 10 years. Columns five and six display the percent changes in supply. The data are from the *Annual Report of the Assistant Commissioner of the Police of the Metropolis Relating to the Contagious Diseases Acts* in 1881. Appendix B.1 provides additional details.

Figure C1 presents the distribution of sex worker ages in the first year in which the CDAs were in force in each district and the tenth year. There is clear evidence that the average age of sex

workers shifted up between these two observations, consistent with a reduction in entry into sex work by younger women.

Figure C1: The Age Distribution of Sex Workers Over Time



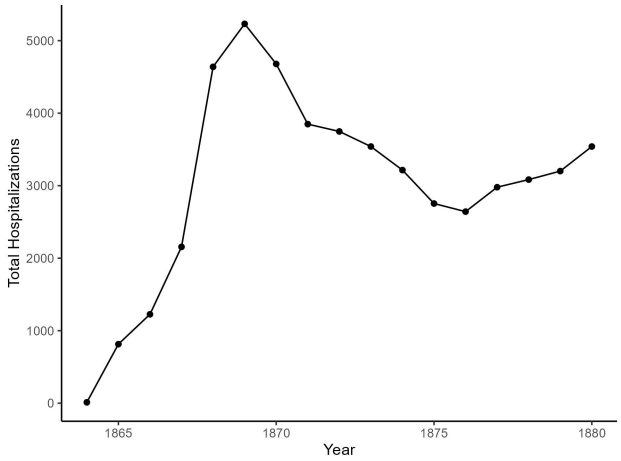
Note: The figure shows the age distribution of registered sex workers for first year after treatment (light bars) and a decade after treatment (shaded bars). The data are from the *Annual Report of the Assistant Commissioner of the Police of the Metropolis Relating to the Contagious Diseases Acts* in 1881. Appendix B.1 provides additional details.

Figure C2 plots the number of sex workers who were confined to a lock hospital for some period under the CDAs, using the police data. Note that the x-axis here is year rather than event time. The increase in hospitalizations from 1865 to 1869 is likely due to the extension of the acts to additional districts across that period. Hospitalizations peaked in 1869 and then fell. That pattern is consistent with a reduction in infection rates as well as a reduction in the number of women inspected as the CDAs reduced the number of sex workers active in the subjected districts.

C.2 Appendix to the analysis of the brothels data

Next, we present some additional results using the brothels data. Column 1 Table C2 presents the average effect corresponding to the event study in Figure 3. This implies treated counties had approximately 39 fewer brothels after the implementation of the CDAs. Columns 2-4 present several robustness checks. First, one concern is that all treated counties are located in the southern part of England. This might raise concerns that counties in the north and in Wales are not effective control counties. Column 2 addresses this by restricting the analysis to counties in the

Figure C2: Hospitalizations under the CDAs Over Time



south western, south midland, and south eastern divisions. The estimated effect is similar to the baseline specification including all counties as controls. An additional concern is that there might be spillovers from treated to nearby counties. While this is a potentially larger concern for the public health analysis later in the paper, we address this in column 3 by dropping all counties that border a county subjected to the CDAs. The estimated effect is nearly identical to the baseline specification. Lastly, London is one of the counties subjected to the CDAs. Given that it is an outlier, throughout the paper we drop London from the baseline analysis. Column 4 presents the estimated effect when London is included. The effect is larger in magnitude, but not statistically significant.

Table C2: The Effect of the CDAs on the Number of Brothels

	$brothels_{ct}$	$brothels_{ct}$	$brothels_{ct}$	$brothels_{ct}$
	(1)	(2)	(3)	(4)
ATT	-38.677	-42.010	-38.012	-88.225
	(11.838)	(13.351)	(12.297)	(54.448)
Observations	689	221	533	702
Specification	Baseline	Southern	No Nearby	With London

Note: The table provides the average of the dynamic treatment effects from estimating Eq. 1 using the method from Callaway and Sant'Anna (2021). In column 1, the outcome is the log of the syphilis hospitalization rate, defined as the number of annual hospitalizations from secondary syphilis per 1,000 soldiers. In column 2, the outcome is the syphilis hospitalization rate in levels. In column 3, the outcome is the log of the syphilis hospitalization rate and the sample is restricted to military stations in England and Wales. Standard errors clustered at the station-level are in parentheses.

C.3 Appendix to the analysis of STI rates among soldiers

This section presents additional results related to the analysis in Section 4.1 on how the CDAs affected hospitalization rates of soldiers from secondary syphilis. Column 1 of Table C3 displays the average effect corresponding to the event study in Figure 5, which implies an approximately 45% reduction in the syphilis hospitalization rate. Columns 2 and 3 present two robustness checks. First, column 2 shows that the effect is robust to using the hospitalization rate in levels as the outcome instead of logs. Lastly, some of the military stations used in the analysis are located in Ireland, Northern Ireland, and Scotland. Column 3 restricts the analysis to military stations in England and Wales which is the region used in other analyses in the paper. The average effect is nearly identical to the baseline specification in column 1.

Table C3: The Effect of the CDAs on Hospital Admissions for Secondary Syphilis

	$\log(rate_{dt})$	$rate_{dt}$	$\log(rate_{dt})$
	(1)	(2)	(3)
ATT	-0.463	-9.848	-0.451
	(0.167)	(3.512)	(0.228)
Observations	475	475	361
Specification	Baseline	Levels	England & Wales

Note: The table provides the average of the dynamic treatment effects from estimating Eq. 1 using the method from Callaway and Sant'Anna (2021). In column 1, the outcome is the log of the syphilis hospitalization rate, defined as the number of annual hospitalizations from secondary syphilis per 1,000 soldiers. In column 2, the outcome is the syphilis hospitalization rate in levels. In column 3, the outcome is the log of the syphilis hospitalization rate and the sample is restricted to military stations in England and Wales. Standard errors clustered at the station-level are in parentheses.

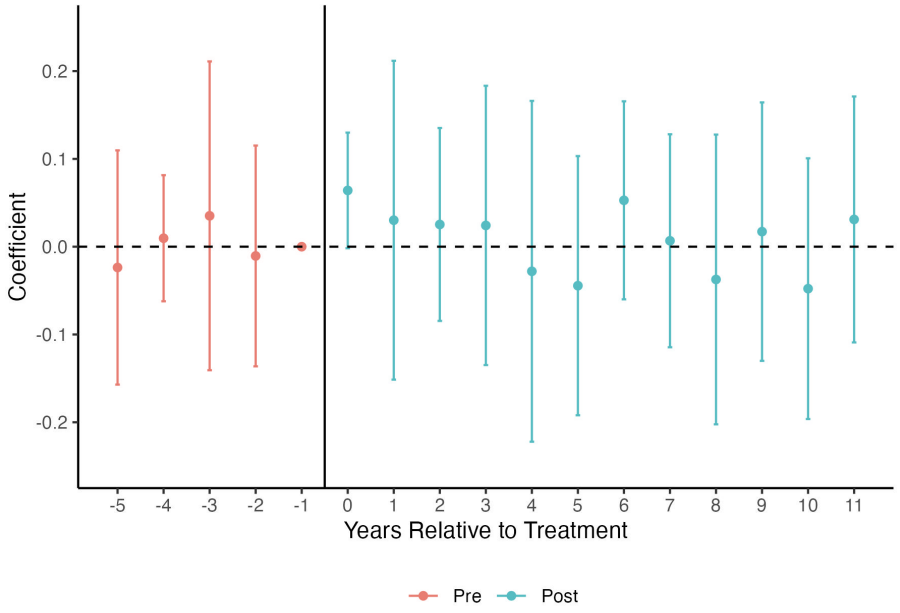
C.4 Appendix to the analysis of STI mortality among the general population

This appendix presents some additional results related to our analysis of mortality patterns among the general population.

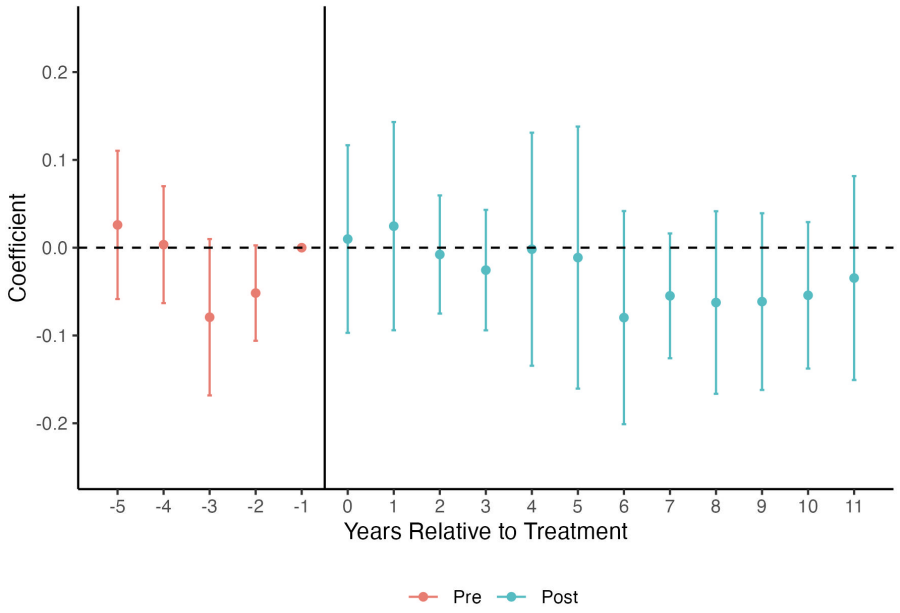
Figure C3 presents event study results looking at the two placebo causes of death that we examine, respiratory mortality and cancer. These figures show no evidence of differential mortality patterns in treated locations corresponding to either the introduction or the repeal of the CDAs. This provides further support for the argument that our main syphilis results are unlikely to be driven by other underlying factors causing mortality patterns to differ in treated vs. control counties around the time that the CDAs were introduced.

Figure C3: The Effect of the CDAs on Cancer and Respiratory Mortality

A. Cancer Mortality



B. Respiratory Mortality



Note: The figure shows the estimated coefficients and 95% confidence intervals for β_s in Eq. 1 estimated using the method from Callaway and Sant'Anna (2021) applied to the log county-level mortality rate. Panel A displays the event study where the outcome is the log mortality rate from cancer and panel B shows the event study for the mortality rate due to respiratory-related causes. The x-axis is in event time relative to the year in which the CDAs became active in any district within the county. We estimate β_s for years in event time in which all treated counties have data available. The vertical line corresponds to the year of treatment. Standard errors are clustered at the county-level.

C.5 Appendix to the analysis of childless couples

Table C4 presents some additional results looking at the impact of the CDAs on childless couples. These results use the district-level analysis specification in Eq. 2. The first three columns look at how the results change if we expand our sample to include couples where the wife's age was between 25 and 45 years old. The next three columns look at how the results are affected by including London in the analysis. Both sets of results are very similar to those presented in the main text.

Table C4: Childless couples robustness

	District-level regressions					
Dep. Var.:	Share of childless couples					
	Couples with wives aged 25-45			**Including London (wives aged 25-40)**		
	(1)	(2)	(3)	(4)	(5)	(6)
CDA Dist	-0.0149***	-0.0124**	-0.0112**	-0.0133***	-0.0116**	-0.0116**
x Post	(0.00469)	(0.00559)	(0.00500)	(0.00469)	(0.00556)	(0.00512)
CDA County		-0.00304			-0.00210	
x Post		(0.00357)			(0.00356)	
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes		Yes	Yes	
County-yr FE			Yes			Yes
Observations	1,645	1,645	1,640	1,645	1,645	1,640
R-squared	0.143	0.144	0.773	0.160	0.160	0.767

*** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses

Next, we consider an alternative approach to analyzing the rate of childless couples that focuses on households, rather than districts, as the unit of observation. The advantage of this approach is that it allows us to include household-level controls as well as to study whether rates of childlessness are also affected by parents' birth locations. However, because the outcome variable is an indicator, the estimated coefficients are less straightforward to interpret. The household-level linear probability model is:

$$\begin{aligned} CHILDLESS_{hit} &= \beta(CDA_i * POST_t) + \eta^F(birthCDA_i^F * POST_t) \\ &+ \eta^M(birthCDA_i^M * POST_t) + X_{hit}\Lambda + \gamma_i + \eta_t + \epsilon_{hit} \end{aligned} \tag{3}$$

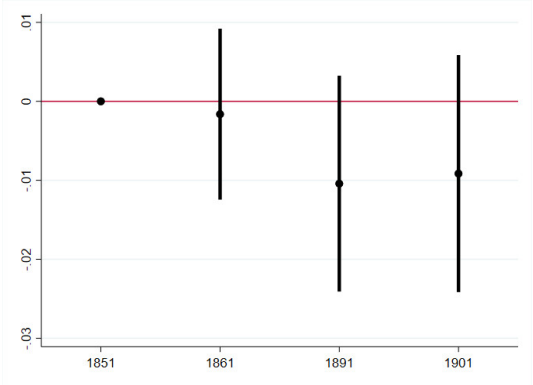
where $CHILDLESS_{hit}$ is an indicator for whether household h in district i in census year t is childless, $birthCDA_i^F$ and $birthCDA_i^M$ are indicators for whether the father or mother was born in a county with a CDA district (district of birth is not observed), X_{hit} is a set of household-level controls, and the other variables are defined as above. As in the district-level results, we cluster standard errors at the district level and exclude London, though we have verified that our findings

are not sensitive to these choices.

Figure C4 presents some event study results based on the specification in Eq. 3 but replacing $POST_t$ with a set of year indicator variables. The results show no evidence of differential pre-trends between treatment and control locations, while we see a fairly substantial drop in the estimated coefficients in the post-treatment period.

Figure C4: Household-level Analysis of the Effect of the CDAs on Childless Couples

DV: Indicator for a childless couple



Note: The figure shows the estimated coefficients and 95% confidence intervals for coefficients estimated using Eq. 3 but replacing $POST_t$ with a set of year indicator variables. Data cover all couples in England and Wales where the wife's age at the time of the census is in [25-40]. N = 5,586,446. Standard errors are clustered by registration district. The regression includes district and year fixed effects as well as controls for wife's age and husband's age. Districts in the county of London are excluded from the analysis.

Table C5 presents household-level results based on Eq. 3. Column 1 presents the baseline results including controls for wife's age and husband's age. As expected, older couples are less likely to be childless. Couples in CDA counties are less likely to be childless, but the estimated effect is not statistically significant (though it is very close to the 90% confidence level). In Column 2, we can see that if either the wife or the husband was born in a CDA county, they couple is less likely to be childless in the post-CDA period. This suggests that treatment operates not only through the couple's current district of residence, but also through their exposure earlier in life. As in the district-level results, we see no evidence of reduced rates of childlessness among couples in counties with CDA districts but who are not actually in the CDA district, suggesting that the CDAs did not have substantial spillover effects onto nearby districts. Finally, Column 3 presents the most demanding specification, which includes county-year fixed effects. This increases the estimated impact of being in a CDA district on childlessness, which is statistically significant at the 90% confidence level, as well as the effect of being born in a CDA county.

Table C5: Household-level analysis of childless couples

Dep. Var.: Indicator for childless couple			
	(1)	(2)	(3)
CDA x POST	-0.00883	-0.00900	-0.0110*
	(0.00595)	(0.00581)	(0.00586)
Treated county x Post		0.00549	
		(0.00573)	
Wife born CDA county x Post		-0.00508**	-0.00576***
		(0.00226)	(0.00220)
Husband born CDA county x Post		-0.00492***	-0.00571***
		(0.00182)	(0.00174)
Husband's age	-0.00170***	-0.00170***	-0.00170***
	(9.49e-05)	(9.49e-05)	(9.48e-05)
Wife's age	-0.00452***	-0.00451***	-0.00451***
	(0.000130)	(0.000130)	(0.000131)
District FE	Yes	Yes	Yes
Year FE	Yes	Yes	
County-yr FE			Yes
Observations	5,586,446	5,586,446	5,586,446
R-squared	0.011	0.011	0.012

*** p<0.01, ** p<0.05, * p<0.1. Standard errors are clustered by district. Based on couples where the wife's age is between 25 and 40. London is excluded from the analysis. Based on specification in Eq. 3.