NBER WORKING PAPER SERIES

FROM HOME TO HOSPITAL: THE EVOLUTION OF CHILDBIRTH IN THE UNITED STATES, 1927-1940

Melissa A. Thomasson
Jaret Treber

Working Paper 10873
http://www.nber.org/papers/w10873

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
October 2004

Thomasson is an Assistant Professor of Economics and a Faculty Research Fellow at the National Bureau of Economic Research. Treber is a Ph.D. student at the University of Arizona. Excellent research assistance was provided by Bradley Epstein, Lauren Hartman and Jill Haubner. We are grateful for comments from Janet Currie, Price Fishback, Gary Libecap, and participants at the All-Ohio Economic Seminar, the 2004 ASSA meetings, Indiana University and the 2004 NBER Summer Institute. Thomasson gratefully acknowledges support from NSF grant # SES-0095990, and support from the National Bureau of Economic Research as a National Fellow during 2002-2003. We accept responsibility for all errors or omissions. The views expressed herein are those of the author(s) and not necessarily those of the National Bureau of Economic Research.

From Home to Hospital: The Evolution of Childbirth in the United States, 1927-1940
Melissa A. Thomasson and Jaret Treber
NBER Working Paper No. 10873
October 2004
JEL No. I12, N32

ABSTRACT

This paper examines the shift in childbirth from home to hospital that occurred in the United States in the early twentieth century. Using a panel of city-level data over the period 1927-1940, we examine the shift of childbirth from home to hospital and analyze the impact of medical care on maternal mortality. Results suggest that increased operative intervention on the part of physicians and a resultant greater risk of infection increased maternal mortality prior to the introduction of sulfa drugs in 1937. However, the introduction of sulfa enabled doctors to reduce maternal mortality by enabling them to do potentially life-saving procedures (such as cesareans) without the risk of subsequent infection. Regressions estimated separately by race suggest that the impact of medical care on maternal mortality differed for blacks and whites. Relative to whites, hospitals posed a greater risk for black mothers prior to the availability of sulfa drugs in 1937, and were less beneficial for them afterwards, suggesting that blacks may have received lower quality medical care.

Melissa A. Thomasson
Department of Economics
Miami University
Oxford, OH 45056
and NBER
thomasma@muohio.edu

Jaret Treber
Department of Economics
University of Arizona
McClelland Hall, Room 401
Tucson, AZ 85721
jaret@bpa.arizona.edu

1. Introduction

The early twentieth-century transformation of the hospital from almshouse to center of medical science is remarkable both in its physical scope and in its social importance. In the late nineteenth century, hospitals were noisy, dirty places that cared for indigents and were operated by charities, religious organizations and government. Respectable persons were cared for at home by their families. As noted by Rosenberg, "No one wanted to enter a hospital in the mid-1870s, except for the small minority of the least enterprising and lacking in self-respect." (Rosenberg 1987, p.116).[1] The relatively primitive state of medical technology meant that there were virtually no reasons for families to seek care in hospitals rather than be attended by physicians in their homes. Medical care consisted primarily of the administering of drugs, a task that could be easily accomplished at home (Temin 1988, p. 79).

As medical technology advanced, the gradual transformation of the hospital from an almshouse to a modern, scientific institution occurred. Hospitals became natural arenas for medical care and science because technological advances necessitated centralization. Rapid advances in bacteriology led to a greater understanding and implementation of complex aseptic surgical techniques that could more easily be performed in specially designed hospital surgical suites than in living rooms. Advances in pathology led to the formation of clinical laboratories in hospitals, and the X-ray became an important, non-portable diagnostic tool.

The centralization of medical technologies in hospitals coincided with the increasing standardization and professionalization of medical education that began in the late nineteenth century. From 1880 to 1904, the number of medical schools in the U.S. increased from 90 to 154, leading some physicians to argue for education reforms to stem the tide of poor-quality doctors that contributed to "dwindling" medical incomes in an "overcrowded" profession (Stevens 1971, p. 60). Neither medical school entrance requirements nor medical school coursework was rigorous. Medical schools did not require a bachelor's degree for would-be medical students, and medical education often consisted of no

[1] A common perception of the day was poor health was often the result of poor moral character. Therefore, hospitals concerned themselves more with curing a person's moral flaws than becoming a steward of medical advances. (Temin 1988, p. 79).

more than two or three years in a training program that was frequently devoid of hospital clinical experience, despite the fact that as early as the 1840s the American Medical Association had indicated the hospital was indispensable in providing training for physicians (Rosenberg 1987, p. 202; Starr 1982, pp. 114-116).

While some universities opened small hospitals of their own to provide clinical teaching for at least some of their students, it was not until the 1890s that significant reforms linking medical education to hospitals occurred. In 1893, Johns Hopkins became the first medical school to treat medicine as a field of graduate study, emphasizing science and clinical experience in their training of medical students. The first two years of the four-year program were dedicated to studying science, while the last two were spent in hospital wards. This reform cemented the marriage of physician education to hospital clinical experience, whereas previous medical school students had learned the practice of medicine "… in their preceptor's office and the patient's home" (Starr 1982, p. 116).

Following the reforms at Johns Hopkins, the American Medical Association (AMA) and the Association of American Medical Colleges (AAMC) pushed for stricter entrance requirements and more rigorous courses of study in all medical schools. The changes at Hopkins spurred reforms elsewhere, and by the time Abraham Flexner published his famous indictment of medical education in 1910, the Hopkins model had become the standard for medical education that other schools strove to imitate.

The link between medical education and clinical experience in hospitals ushered in the era of hospital-based medicine. On the supply side, physicians trained in hospitals came to view hospitals as physician workshops, and as the number of physicians trained in hospital settings continued to grow, the shift in medical care from home to hospital began in earnest. Hospitals focused on image-building and customer-service, specializing in obstetrical deliveries, tonsillectomies, and appendectomies—all procedures with usually happy outcomes (Stevens 1989, p. 105). On the demand side, the decline in average family size that occurred with urbanization further spurred the shift as families moved into smaller homes with fewer people left in the home to care for the sick (Vogel 1980, p. 99; Temin 1988, p. 83). Medical discoveries such as the prophylactic treatment of rabies (1885), diphtheria antitoxin (1891),

and tests for typhoid (1897) and syphilis (1906) lent a new scientific aura to medicine (Rosenberg 1987, p. 159). By 1920, American upper- and middle-class families began to accept hospitals as a consumer good, and hospitals catered to this new consumerism.

While the shift from home to hospital is well-documented, what is less clear is the extent to which this shift occurred because it benefited practitioners or because it benefited patients. Obstetrical care in particular is a remarkable example of the shift from home to hospital, and an example in which the reasons underlying the shift may not have been due to the fact that women received better care in hospitals than in their homes. In 1900, only five percent of all births occurred in hospitals (Wertz and Wertz 1977, p. 133). Particularly in urban areas, the shift from home to hospital occurred quickly. By 1935, nearly 75 percent of urban births occurred in hospitals, and nearly all urban births occurred in hospitals by 1950.[2]

Despite the rapid shift from home birth to hospital birth, Figures 1 and 2 show that maternal mortality remained flat until the mid-1930s, even as death rates among women due to other causes such as respiratory tuberculosis decreased. Figure 1 shows total, urban (places over 10,000) and rural maternal mortality from 1915-1940. Strikingly, maternal mortality was higher in urban areas than in rural areas until the late 1930s when sulfa drugs became available, even though women in urban areas had greater access to physicians and hospitals. Figure 2 shows the death rate among women for tuberculosis and all causes related to childbirth (puerperal causes) from 1900-1940. While tuberculosis death rates fell throughout the period, maternal mortality did not begin to decline until the 1930s. Ignoring the spike in maternal mortality rates associated with the 1918 influenza epidemic, maternal mortality death rates are essentially flat until the 1930s, even as childbirth increasingly moved from home to hospital over the period.[3] Further, infant mortality rates due to birth injuries increased 40-50 percent between 1915 and

[2] The transition occurred more slowly in rural areas initially. In 1935, roughly 20 percent of rural births occurred in hospitals. By 1950, over 70 percent of rural births occurred in hospitals, and by the 1960s, it was rare for any birth to occur outside of a hospital (Leavitt 1986, p. 171; Wertz and Wertz 1977 p. 135).

[3] The spike in 1918 due to influenza occurs because the U.S. classified influenza deaths among pregnant women as due to puerperal causes instead of influenza. When joint causes of death were present, they were coded using the *Manual of Joint Causes of Death* prepared by the U.S. Bureau of the Census. For each cause of death, the *Manual of*

1929 as hospital birthrates increased (White House Conference on Child Health and Protection 1933, pp. 215-217).

It could be argued that the seeming rise (or lack of decline) in maternal mortality rates may have resulted from improved reporting of maternal deaths as time progressed, or because a decline in the birth rate meant that more hazardous first births accounted for a greater share of total births over time. However, neither of these reasons can fully account for the trend in maternal mortality from 1900-1940. Improvements in reporting could have led to a seeming increase in maternal mortality for two reasons. First, states with higher mortality rates may have been admitted to the U.S. death registration area later than states with lower rates. As these higher mortality states were admitted, the U.S. overall maternal mortality rate would increase. While plausible, it does not appear to be the case that an increasing number of states admitted to the death registration area was responsible for the trend in maternal mortality. Even in those states that were in the death registration area in 1900, maternal mortality did not decline over the period. Figure 3 shows the essentially flat trend until the 1930s in Massachusetts, a state that had collected maternal mortality data since 1850. Further, international comparisons, shown in Figure 4, reveal that both England and Sweden had flat or rising maternal mortality rates during the same period, even though they possessed fairly accurate vital statistics data (Loudon 1992, p. 240).[4]

Another reason why the increase in maternal mortality in the early twentieth century may be an artifact of the data is that there may have been a tendency on the part of physicians to misreport deaths from puerperal fever in order to avoid blame (Loudon 1992, pp. 35-36). While such deaths were usually classified as due to another puerperal cause such as hemorrhage, so that the overall maternal mortality rate would be the same, some doctors may have coded deaths from puerperal infection as due to non-

---

Joint Causes tells what other causes are "preferred" and should be listed as the primary cause if both are present. For example, puerperal septicemia as a primary cause took precedence over tuberculosis, but not over syphilis.

[4] A note of caution when looking at this figure: the levels are difficult to compare because of differences between countries in classifying deaths due to joint causes (for example, Sweden and England coded joint deaths in which the mother had influenza as due to influenza, not due to puerperal causes as was done in the U.S., so that the U.S. has a spike in maternal mortality during the influenza epidemic that is not seen in international data). A study done in 1927 found that the rates in England and Sweden would be higher if classified using the American method, although the rank order would be the same (Tandy 1935).

childbirth related causes. As the quality of vital statistics reporting improved over time, these deaths may have been more accurately reported, so that maternal mortality seemed to increase. These effects were undoubtedly present, but probably small and not large enough to obscure the overall trend, especially by the 1920s. In a 1917 study that investigated maternal mortality in the U.S. and examined the quality of the data, Meigs states, "… it is safe to say that any marked decrease in the actual death rate from childbirth during the last 13 years could not have been masked by "the improvement in reporting deaths from childbirth (Meigs 1917, p. 18).

Even if the data were accurately reported, it may be that maternal mortality failed to decrease over this period because a decline in the birth rate meant that more hazardous first births (primiparity) increased as a share of total births. While it is true that first births are more hazardous than second or third births, it is also true that grand multiparity (four or more births) is more hazardous as well (Loudon 1992, p. 242). If birth rates were declining, then primiparity was increasing, but grand multiparity was decreasing. Thus, the increased risk of maternal mortality associated with higher primiparity may have been offset by the decreased risk of maternal mortality associated with lower grand multiparity. Statistics available from 1920-1940 suggest that as the total birth rate per 1,000 women aged 10-54 fell from 72.6 births to 52.3 births, the percentage of first births as a share of total births rose from 29 percent to 37 percent. At the same time, the share of fourth and subsequent births fell from 35 percent to 24 percent (Linder and Grove 1947, Table 48, Table XIV-A). Given that the decrease in grand multiparity more than offsets the increase in primiparity as a share of total births, it seems unlikely that the overall trend in maternal mortality can be attributed to changes in fertility.

The data clearly suggest, then, that maternal mortality was not decreasing over the period 1900-1940 even as hospital birth rates increased. If, ostensibly, one of the primary reasons underlying the shift from home to hospital birth was that hospitals provided greater safety for women and infants during labor and childbirth, why was this effect not seen in declining maternal mortality rates? Several historians have argued that stagnant maternal mortality rates and rising rates of infant mortality due to birth injury occurred as a result of increased operative intervention on the part of practitioners as birth moved from

the home to the hospital, combined with a lack of set standards for the practice of obstetrics. Unnecessary intervention may have led to excess maternal deaths for a number of reasons. A primary cause of maternal mortality was puerperal septicemia, and increased operative intervention in the form of version, forceps delivery and cesarean section all increased the likelihood of such an infection. Complications from anesthesia could also lead to maternal death. How preventable was maternal death in this period? Two studies in the early 1930s claimed that between half and two-thirds of maternal deaths could have been prevented by better training of the attendants (White House Conference on Child Health and Protection 1933; New York Academy of Medicine 1933 p. 213). If these arguments are correct, then modern medicine may have actually increased the number of maternal deaths due to childbirth than otherwise would have occurred.

This paper uses a panel of city-level data over the period 1927-1940 to examine the shift of childbirth from home to hospital and to analyze whether or not medical care contributed to maternal mortality. Results indicate that medical care generated a slight increase in maternal mortality prior to 1937, and a slightly larger decrease after 1937 when sulfa drugs became available. The remainder of the paper is structured as follows. Section 2 discusses the background and history of childbirth in the United States, and frames the model discussed in Section 3. Section 4 describes the data and results, while Section 5 concludes.

2. The History of Childbirth in America

Childbirth Prior to 1900

Before 1750, women controlled childbirth. Typically, a pregnant woman entering confinement requested the attendance of a midwife and several close friends and relatives who would aid her during the process of childbirth in her home. The technology of childbirth was relatively simple; midwives were generally passive but supportive participants in the birthing process, especially during normal deliveries. They were able to turn breech births, but in complicated cases could do little to prevent either maternal or infant death (Wertz and Wertz 1977, p.17-18). Women feared childbirth, and while actual data are scarce, Leavitt notes that women's diaries in colonial times (and even through the turn of the twentieth century)

showed that "… an important part of women's experience of childbirth was their anticipation of dying or being permanently injured during the event" (Leavitt 1986, p. 14).

Medical intervention during childbirth, even the presence of a physician during labor and delivery, was rare until after 1750, when men trained as physicians abroad returned to practice in America (Wertz and Wertz 1977, p. 29). Physicians trained in the "new midwifery" in Europe brought forceps to the United States, offering middle- and upper-class women an alternative to traditional, midwife-attended childbirth.[5] The fear of childbirth led women to invite physicians (and their promises of greater safety and less pain) into the birthing room (Leavitt 1986, pp. 37-38). With forceps, physicians could assist women in difficult births, or hasten slow deliveries. Technological developments such as with the introduction of ergot (a drug used to cause uterine contractions), and the advent of pain-relieving drugs such as ether and chloroform also provided physicians with an aura of science that led more and more women to choose to have physician-attended births. General practitioners were eager to accommodate women. They viewed childbirth as central to their attempts to build a practice, given that successful births led to more patients (Wertz and Wertz 1977, p. 67) At the same time, midwives, most of whom were without formal education and who lacked professional organization, gradually attended fewer and fewer births as the century progressed.

The idea that physician-attended deliveries were in fact safer was not necessarily true; while there are no records of epidemics of puerperal fever in America during the 18th century, puerperal fever became more common in America after 1840, perhaps because of increasing physician intervention during childbirth (Wertz and Wertz 1977, p. 119). Regardless, by the end of the nineteenth century nearly 50 percent of all births were physician-attended, although the majority still occurred in women's homes. Most middle-and upper-class white women were attended by physicians in their homes during childbirth, while Southern black families and immigrants relied heavily on midwives (Litoff 1978, p. 26). The only

[5] An Englishman named Peter Chamberlen is believed to have invented forceps in the early 17th century. The device consisted of "… two enlarged spoons with handles" that could be joined and locked together. The Chamberlen family kept the device a secret for over 100 years, so that they were not widely used until after 1800 (Wertz and Wertz 1977, pp. 34-35; Radcliffe 1967, pp. 31-32).

births that occurred in hospitals were those of homeless women or women who could not receive in-home assistance (Leavitt 1986, p. 61).

Childbirth After 1900

After the turn of the century, the shift from home to hospital began in earnest, although it occurred slowly at first. A Children's Bureau study conducted in Baltimore in 1915 sheds some light on trends in urban areas. By 1915, the percentage of births attended by physicians had increased, and women were more likely to deliver in hospitals (Rochester 1923, pp. 212-213). However, as shown in Tables 1a and 1b, the percentage of women attended by physicians and delivering in hospitals varied widely by both income and nationality of mother. Table 1a shows that physician-attended births in Baltimore hospitals were highest among families where the father reported no earnings and among the highest-earning fathers. Middle-class families were more likely to deliver at home while being attended by a physician, while midwives generally limited their services to middle- and lower-income families. Table 1b illustrates the fact that foreign-born mothers in Baltimore were more likely to use midwives than native-born mothers, usually because of a reluctance to admit men into the birthing room. Only 27.4 percent of infants born to white, native-born mothers were delivered by midwives in 1915, while midwives attended the births of over 77 percent of Italian-born women.

The Rise of the Physician and Hospital-Based Childbirth

What engendered the shift from home to hospital based childbirth in the first decades of the twentieth century? On the supply side, reforms in medical education, increasing professional organization and specialization among physicians, the economic gains that accrued to physicians who had hospital-centered practices, and the disappearance of the midwife as an alternative to physician-attended birth all played a role in the transition of birth from home to hospital.

By the turn of the century, reforms in medical education were well underway. The impetus for reform stemmed from the success of the Johns Hopkins model and the willingness of American

philanthropists to fund improvements in medical science and education.[6] However, the chief proponent for change became the newly restructured and more powerful American Medical Association (AMA).[7] The AMA recognized the fact that improving standards would not only lead to additional funding of medical school endowments and improvements in the quality of medical care, but would also serve to reduce the number of medical practitioners at a time when many physicians were struggling financially. The problem of "overcrowding" in the profession was referred to in several articles at the turn of the century. A *Journal of the American Medical Association* (*JAMA*) editorial written in October, 1901 stated, "It is evident from the census statistics that we must be rapidly approaching the limit of additions to the medical profession if the individual members are to find the practice of medicine a lucrative occupation" (*JAMA*, October 26, 1901, p. 1119).

Regardless of motive, the reforms in medical education that occurred in the first two decades of the twentieth century influenced the shift in childbirth from home to hospital in two ways. First, reforms in medical education focused on the close incorporation of hospitals with physician education. Prior to the twentieth century, most physicians had little clinical experience in hospitals. Even before the Flexner Report was published in 1910, medical reformers recognized the need for a close tie between hospitals and medical training.[8] Thus, increasing numbers of physicians were routinely trained in hospitals and came to view hospitals as workshops in which they could use the latest medical technologies. With respect to childbirth, hospitals enabled physicians to use technologies that may have been more difficult at home. For example, physicians often had physical difficulty utilizing forceps in the home birthing bed,

---

[6] Stevens notes that endowments to medical schools rose as educational standards increased. She quotes the president of Harvard in 1907 as stating "Gentlemen, the way to get endowment for medicine is to improve medical education." *American Medical Association Bulletin*, 1907, p. 263, quoted by Stevens 1971, p. 60.

[7] The growth in AMA membership over the time period is striking. While the reorganization of the AMA in 1913 to include all members in good standing with local medical societies makes it difficult to compare AMA membership over time, Burrow notes that by comparing the number of AMA fellows (members who were in good standing with a local society, actually applied for AMA membership, subscribed to the Journal and paid the annual fee) with the number of members before 1913 allows for nearly parallel comparisons. Total fellows in the AMA in 1920 equaled 47,045 (of total membership of 83,338), compared to 8,401 members in 1900. (Burrow 1963, pp. 49-50).

[8] Some philanthropists encouraged the development of ties between medical schools and hospitals. Markowitz and Rosner (1973) note several incidences where philanthropists and other industrialists "… attempted to foster consolidation of the medical school and hospital by giving money with certain substantial strings attached," usually requiring hospitals to allow medical schools to use their facilities for teaching (p. 103).

and some types of anesthesia were best administered in a hospital environment. Further, an increasing awareness of the importance of a germ-free environment to prevent puerperal fever led doctors to prefer hospital-based over home-based childbirth (Leavitt p. 177).

In addition to being more comfortable practicing in a hospital setting, physicians also found that centralizing childbirth in hospitals was more convenient and perhaps more lucrative. They no longer had to carry their equipment and travel great distances to women's homes to attend labor and delivery, and hospitals provided trained nurses to assist doctors during delivery (Wertz and Wertz 1977, p. 144; Vogel 1980, pp. 102-103). In addition, hospital-centered practices may have allowed doctors to increase their incomes. Doctors could see more patients than they could if they traveled to patient's houses, and hospitals enabled them to do more complicated (and more expensive) procedures. The idea that physicians may have used excessive intervention to increase their incomes is in line with the modern theory of "supplier-induced demand." For example, Gruber and Owings (1996) found that the decrease in fertility that occurred from 1970-1982 led obstetricians to substitute normal childbirth with more highly compensated cesarean deliveries. Two studies published much earlier are also suggestive of the presence of supplier-induced demand. A 1915 Children's Bureau study found that physicians used forceps (for which they were reimbursed more) in only 4.3 percent of births in families with fathers earning less than $450, compared to 14.2 percent of births in families with earnings over $1,850 (Woodbury 1925, p. 236). Similarly, results from the National Health Survey of 1935-1936 found that the cesarean birth rates varied from a low of 1.4 percent among those families on relief to 3.7 percent among those women with a family income of $2,000 or more. Even more striking, the percentage of hospitalized women undergoing episiotomy ranged from a low of 25 percent among relief families to nearly 50 percent among women with family income over $2,000. (Goddard 1941, pp. 44-45).

The second reason reforms in medical education helped to foster the shift in childbirth from home to hospital was that they were part of a larger effort by the AMA to increase the level of professional organization and status among physicians, activities that may have in turn reduced the number of non-physician practitioners (such as midwives) that were available as alternatives to physician-attended

childbirth. As the scope of medical knowledge broadened, greater numbers of physicians sought to specialize in an area of medicine rather than practice as generalists.[9] State licensing requirements rose with increasing standards in medical education, and physicians resisted efforts by non-medical competitors to treat patients (Stevens 1971, p. 99-100). The desire to reform obstetrics education and to raise the status of obstetricians led some physicians to call for the elimination of the midwife. Physicians may have felt threatened economically by midwives, who typically received one-half the fee charged by physicians for performing obstetrics services (Litoff 1978, p. 73; Chapin 1923, p. 77). Further, some suggested that midwives took teaching opportunities away from medical students, particularly midwives who worked on charity cases. Accordingly, many physicians regarded midwives as inferior substitutes and blamed them for high rates of maternal mortality. A physician writing in the *American Journal of Obstetrics and Diseases of Women and Children* in 1911 stated:

> …40 to 50 per cent. of the births in the large cities of this country are attended by midwives who, except in some rare instances, are ignorant, untrained, incompetent women, and some of the results of their obstetric incompetence are unnecessary deaths and blindness of the infants, and unavoidable invalidism, suffering and deaths of the mothers…the gist of the matter is that one or two things must be done with the midwife—she must be eliminated or educated and placed under state control. (Edgar 1911, p. 881).

Indeed, there is little disagreement that untrained midwives contributed to high maternal mortality rates. However, it is not clear that trained midwives were any more hazardous than poorly trained physicians, especially since the maternal mortality rate did not fall as fewer and fewer women were delivered by midwives over time. Speaking in 1911 to the New York Academy of Medicine about the "midwife problem", a New York physician noted that "… much that is said to-night concerning the evil results of midwife practice here in New York, can be said—even to a higher degree—of the physician. The poorly trained physician does far more harm than the midwife, as is abundantly shown by the various hospital records as well as by the records of the Board of Health" (Lobenstine 1911, p. 879).

[9] Only 23 percent of medical students graduating in 1915 went on to practice solely as general practitioners. Thirty-six percent developed a specialist interest, while 41 percent limited themselves entirely to a specialty (Stevens 1971, p. 116). As more physicians became specialists, specialists sought to organize and delineate their specialties. The American College of Surgeons (ACS) was founded in 1912 to standardize surgical quality and to openly distinguish between "quality" surgeons and other surgical practitioners. Other specialties soon followed suit.

Some physicians and public health officials were actually in favor of training and regulating midwives to reduce maternal mortality. Midwife proponents pointed to the much lower puerperal death rates experienced by some European countries that relied almost exclusively on trained midwives to deliver pregnant women. Mothers in Sweden and England relied more extensively on midwives than did mothers in the U.S., and midwives in these countries were better trained and regulated (Loudon 1992). Despite the much greater number of births delivered at home, both England and Sweden realized much lower levels of maternal mortality than the United States, as shown in Figure 4.

In America, further evidence of the ability of trained midwives to reduce maternal mortality is given by the example of the Kentucky Frontier Nursing Service, founded by Mary Breckinridge, a nurse who later trained as a midwife in England. In the Frontier Nursing Service, more than 30 nurses trained as midwives in England and then provided midwifery services to families in rural Kentucky. Over the period 1925-1937, the nurse-midwives delivered 3,000 babies. Physicians were called in to perform cesarean sections 6 times, and forceps were used only 14 times. The maternal mortality rate associated with the Frontier Nursing Service over the period was 6.8 deaths per 10,000 births, in contrast to 56-68 deaths per 10,000 births for the U.S. as a whole, and 80-90 deaths per 10,000 births for white women delivered in hospitals in Lexington. (Dye 1983, pp. 501-502). New York City and New Jersey also experienced significant declines in infant mortality after implementing midwife training and regulatory programs (Litoff 1978, p. 93).

Despite the efforts of midwifery proponents, the percentage of births attended by midwives decreased from 50 to 12.5 percent over the period 1900 to 1935 (Loudon 1992, p.298).[10] The absolute number of midwives declined from 7.39 midwives per 100,000 people in 1900 to 2.90 per 100,000 in 1930. This trend was particularly pronounced in large cities. Southern states reported greater numbers of midwives throughout the period, and lower levels of decline, as seen in Figure 5.

[10] In New Jersey, 42 percent of births were attended by midwives in 1918, compared to less than 19 percent in 1930. By 1930, 80 percent of midwives were in the rural South (Stevens 1971, pp. 100, 180).

Efforts by physicians to discredit the midwife profession were likely responsible for at least some of this decrease, as physicians regarded midwives as a "… temporary stopgap until all patients could be delivered by physicians" (Stevens 1971, p. 180). States began to pass laws to regulate midwives over this period, and one state (Massachusetts) even outlawed midwifery (Litoff 1986, p. 9).[11] Overall, these laws did little to reduce the number of midwives as they were fairly lenient and poorly enforced. There were many other factors that contributed to the decline of midwives (Litoff 1986, pp. 9-10). In contrast to physicians, midwives were not professionally organized, and given that many midwives were women who attended blacks and immigrants, they may have lacked a political voice. Midwife proponents were less organized than opponents, and the demand for midwife services also fell as immigration declined (Litoff 1978, p. 113).

Advances in Anesthesia and Women's Preferences for Hospital Birth

While supply-side factors such as the increasing professionalization of physicians and their preferences for hospital-centered births, and the fact that fewer midwives were available to serve as alternatives doubtlessly contributed to the shift of birth from the home to the hospital, demand-side factors also played a role. Some women may have simply preferred hospital births over home births. With technological advances in anesthesia, more and more women turned away from midwives and turned to physicians who could administer anesthetics during labor and delivery. As hospitals shifted their focus to customer-service, they offered women greater comfort and assistance than women could receive at home. Trained nurses could assist women, and lengthy hospital stays permitted women to rest and escape household duties.[12] Safety concerns also prompted women to adhere to their physician's advice regarding

[11] In 1896, the year Washington, D.C. enacted a law requiring midwives to pass an examination, midwives attended 50 percent of all births. By 1910, midwives attended less than 10 percent (Chapin 1923, p. 77).

[12] Even after a nursing shortage following World War II shortened obstetrical length of stays in hospitals, ward patients stayed an average of two weeks post-partum, and private, paying patients often stayed as long as three weeks, perhaps they "…appreciated the efficiency of transferring to an institution the whole daily round of care, feeding, and washing that could hardly be done anymore in the home" (Wertz and Wertz 1977, p. 156). Leavitt also suggests that urbanization transformed birth from a "woman-centered" event where a woman's friends and relatives

hospitals. Childbirth in the early twentieth-century was hazardous; a 1917 report noted that childbirth in 1913 caused more deaths among women 15 to 44 years old than any disease except tuberculosis (Meigs 1917, p. 7). Advertisements in popular women's magazines trumpeted the virtues of hospital births by proclaiming that "…motherhood is easier and far safer due… to the modern hospital and the great strides made in obstetrics" (*Ladies' Home Journal*, September 1930, p. 83). Advertisements also frequently touted their products as those used by "hospital leaders" and as "hospital-safe" (*Ladies' Home Journal*, February 1932, p. 120).

While doctors' advice, comfort, convenience, and supposedly greater safety played a role in the shift from home to hospital birth, the availability of anesthesia also contributed to a growing demand for hospital birth. The advent of pain relieving drugs and techniques, notably "Twilight Sleep" in 1914 (Leavitt 1986, p. 130 and Wertz and Wertz 1977, p.150), likely played a large part in convincing women that hospitals were more comfortable than homes for delivering a child. Although ether and chloroform had been used since the mid-1800s, they were far from ideal. Induction and recovery were slow with ether, and while women were induced much faster using chloroform, it carried higher risks of cardiac complications (Rushman, Davies, Atkinson 1996, pp. 23-26). Most other drugs could not be administered until late in labor, so that women still experienced pain (Leavitt 1986, p. 127).

An advance in the early twentieth-century opened the door for greater anesthetic possibilities. Unlike earlier methods, "twilight sleep" involved the administration of the amnesiac scopolamine, which did not relieve pain but rather prevented women from remembering the painful experience. Pioneered in Germany, U.S. physicians were reluctant to use twilight sleep since they were unsure of its safety. Complications included delayed labor, and infant respiratory depression (Sandelowski 1984, pp. 11-15). Women sometimes had to be restrained during its use, making the hospital the preferable setting for delivery (Sandelowski 1984, p. 16). By slowing labor and incapacitating women, twilight sleep often required obstetrical interventions such as the administration of Pituitrin (a drug used to increase

took care of her and her family both during labor and after delivery to one in which women could not find the help they needed (1986, p. 175).

contractions) and the applications of forceps to deliver infants. Despite its drawbacks, women campaigned vigorously for its adoption. Proponents of twilight sleep included many wealthy society women, including Mrs. John Jacob Astor, whose picture appeared in newspaper articles endorsing the method (Leavitt 1986, pp. 131-33; Wertz and Wertz 1977, pp. 150-54). While the popularity of the Twilight Sleep method faded somewhat after 1915 when a noted advocate died during childbirth, the furor it initially created served to increasingly medicalize childbirth, and to make obstetrics an increasingly surgical specialty that routinely involved anesthesia and instrumental intervention.

Because of these reasons, increasingly large numbers of American women began to give birth in hospitals. The image of hospitals as safer places to give birth, however, is little supported by empirical evidence. Maternal mortality rates were flat and in some cases increasing until the 1930s, and several studies blamed the increase on excessive physician intervention in childbirth.[13] As early as 1880 physicians were aware of the streptococci bacteria that caused sepsis, often called "child-bed" or "puerperal" fever. Nevertheless, puerperal septicemia remained a leading killer of women of childbearing age until the mid-1930s, when the anti-infective sulfonamide drugs were developed.[14] Women attended by physicians and giving birth in hospitals prior to 1936 may have been at increased risk for septicemia, given that they were much more likely to have some sort of physical intervention. Results from the 1935-1936 National Health Survey found that forceps were used "… with two or three times the frequency" in hospital deliveries compared to nonhospitalized deliveries (Goddard 1941, p. 47). One prominent

[13] A study conducted by the Children's Bureau in 1927 and 1928 found that maternal deaths due to puerperal causes were 36 percent higher in urban areas than in rural areas (Maternal Mortality in Fifteen States Children's Bureau 1934, p. 19). Loudon (1991, p.294) and Leavitt (1986, p.183) also provide evidence that maternal deaths due to puerperal fever remained higher in urban areas than in rural areas. Given the higher incidence of hospital births in urban than rural areas this may suggest that hospitals may have actually increased the risks associated with childbirth. Further evidence is suggested by interracial comparisons: Despite the fact that white mothers were hospitalized with much greater frequency than nonwhite infants (twice as many white births occurred in hospitals than did nonwhite births), the racial gap in maternal mortality did not widen and even narrowed during this time period (Loudon 1991, p. 299).

[14] Until sulfa drugs were developed, between 35-55 percent of maternal deaths were due to sepsis. Twenty percent were due to eclampsia, 20 percent due to hemorrhage, with the remainder due to other causes such as abortion (Loudon 1991, p. 34). Dr. Gerhard Domagk described the antibacterial properties of the first sulfa drug (called "Prontosil" in results published in February, 1935. The antibacterial action came from the drug's sulphonamide compounds, which were generally effective against streptococcal agents, and to a lesser extent against staphyloccal infection. Domagk won the 1939 Nobel Prize for Physiology or Medicine for his work.

physician, Joseph B. DeLee, recommended the routine use of episiotomy and outlet forceps after sedating patients with ether and scopolamine. Describing this as the "prophylactic forceps operation," DeLee stated that the technique was a "…rounded method for relieving pain, supplementing and anticipating the efforts of Nature, reducing the hemorrhage, and preventing and repairing damage" (DeLee 1920, p. 34).[15] This "meddlesome midwifery" may have increased morbidity and mortality among childbearing women. Drugs slowed delivery and necessitated interventions such as forceps that could transmit infection. Physicians who inappropriately applied forceps risked lacerations of the cervix and perineum, as well as infection and hemorrhage.

Two studies conducted in the early 1930s confirmed the notion that physician interference may have harmed women. A study conducted by the New York Academy of Medicine from 1930-1932 found the septicemia death rate to be 1.67 deaths per 1,000 live births in the hospital, but only 0.90 deaths per 1,000 live births for infants delivered at home.[16] A second study conducted by a subcommittee of the White House Conference on Child Health and Protection also suggested that excessive interference led to increased morbidity and mortality, with the result that "… all the advances in medical knowledge have been almost lost to the parturient woman through too great a recourse to instrumental delivery" (White House Conference 1933, p. 18).

3. Model

Despite the purported claims of increased maternal safety associated with hospital birth, Section 2 shows that it is not clear that hospitals really led to safer birth outcomes for mothers. However, if hospitals were really actually dangerous for mothers, would more and more women voluntarily give birth in hospitals? In this paper, we seek to statistically examine the link between hospital births and maternal mortality. Loudon (1991) suggests that there are two views that explain differential maternal mortality rates. The first is that "…high mortality is due to poor obstetric practice and low mortality to good

[15] Other doctors such as J. Whitridge Williams believed that DeLee proposed excessive intervention, a debate that played out in medical journals in the 1920s (Leavitt 1986, p. 120).

[16] Even if cesarean sections are excluded, the hospital maternal mortality rate falls to 1.07—still 18 percentage points higher than the maternal mortality rate associated with home births (New York Academy of Medicine 1933, p. 85).

practice" whereas the second is that the underlying causes of high maternal mortality "…can be found in the social, economic, and political conditions of a population" (Loudon 1991, p. 34). By attempting to control for medical inputs as well as the socioeconomic conditions that prevailed at the time, we seek to shed light on the question of whether or not the shift to hospital births actually benefited women.

We begin by using city-level data for the period 1927-1940 that allow us to control for different factors—both medical and socioeconomic—that may have impacted maternal mortality rates.[17] To capture medical factors that may have impacted maternal mortality rates, we include a control for medical inputs. Ideally, this variable would be measured as the percentage of all births in a city occurring in hospitals; however, it is not possible to construct this variable for every year in the sample. Instead, we use hospital beds per 100,000 population to control for medical inputs. Presumably, cities with greater numbers of hospital beds may have provided greater levels of physician-attended, hospital births for several reasons. First, the costs (both actual costs and travel costs) of using a hospital may have been lower in cities with more hospital beds per 100,000. In addition, if physicians are more likely to locate in areas with greater numbers of hospital beds, then this may have increased the probability that a pregnant woman sought a physician's assistance during delivery and thus increased her chance of delivering in a hospital.

A priori, it is not clear whether the sign on the estimated coefficient on hospital beds per 100,000 should be positive or negative. Clearly, physicians and mothers believed that hospital births were safer. Undoubtedly, the lives of some women were saved by the efforts of a physician during difficult births. On the other hand, we are aware that excessive medical intervention may have claimed lives. It is possible that the impact of medical inputs on maternal mortality changed during the period of time we are considering. In particular, with the introduction of sulfa drugs in the spring of 1937, obstetricians were able to more effectively combat puerperal infections. After sulfa drugs were introduced, doctors could

[17] Ideally, we would like a panel of city level data from 1920-1950 to more fully capture the shift, given that maternal mortality already begins to fall in the early 1930s. However, consistent city-level information on hospitals is not available until 1927, and beginning in 1943, only county information is reported on maternal mortality. Thus, we limit ourselves to the 1927-1940 period.

intervene with less chance of spreading an infection that would later claim the mother's life. For this reason we included a dummy variable indicating observations prior to 1937 as well the interaction between this variable and hospital beds per 100,000 in order to distinguish between pre- and post-1937 effects of medical care on maternal mortality.

In order to control for socioeconomic characteristics that may have affected maternal health, we include county level measures of education, real income per capita, and race. Construction of the variables is discussed in the data appendix. Education may be important if maternal health practices influenced maternal mortality. For example, educational deficiencies might also have facilitated the continuing influence of superstition, folk remedies, and "lay referral" even when modern medical care and information was available (Beardsley 1987, pp. 32-35). In addition, better educated people appear to be more behaviorally responsive to health-related information than others (Berger and Leigh 1989, Kenkel 1991, Meara 2001). The percent of the population that is illiterate is included as a measure of educational attainment. As a proxy for income, we include real retail sales per capita (Fishback et al 2001). Income may be important for several reasons. First, women with higher incomes may have been better nourished and thus better able to withstand childbirth and its potential complications. This suggests that the estimated coefficient on the income variable should be negative. Higher income families may have also been able to obtain better access to medical care. To the extent that medical care lowered maternal mortality, this suggests that the estimated coefficient on the income variable should be negative. However, if medical care did increase the risk of maternal mortality, and to the extent that the hospital beds per 100,000 variable inadequately captures the impact of medical care on maternal mortality, then the estimated coefficient on the income variable may be positive.

The percentage of the population that is black (also from the census) is included to measure the extent to which racial differences impacted maternal mortality. Finally, women under 16 years of age and women over 35 are at a greater risk for puerperal complications (Cunningham et al 1997, pp. 570-572). As a control for this potential maternal health risk we include variables reflecting females in various age

groups as a percentage of women in their childbearing years (ages 15 to 44). Thus, our basic regression equation is:

$$MMR_{it} = Z_{it}\alpha + Y_t\theta + [Y_t * Z_{it}]\pi + X_{it}\beta + e_{it},$$

where *i* refers to cities, *t* refers to years, Z_{it} reflects hospital beds per 100,000, Y_t is the dummy variable indicating whether the observation occurred prior to 1937, and X_{it} includes the city-year characteristics described above. In some specifications we include state dummies to capture any additional effects that vary across states but were constant over time. Finally, because it could be the case that cities that were added to the registration areas after 1927 may have had greater levels of maternal mortality and more incomplete registration of maternal deaths as well as infant births, we run a balanced panel consisting of only those cities that were in the sample in the first year (1927) and an unbalanced panel consisting of all cities regardless of when they entered the sample. Table 2 presents summary statistics for the variables.

4. Results

Regression results are reported in Table 3. Looking at the results for the balanced panel in column [1], the estimated coefficient on the beds per 100,000 population variable is negative and statistically significant, suggesting that beginning in 1937, an increase of 100 beds per 100,000 population resulted in 10.5 fewer maternal deaths per 100,000 births. The estimated coefficient on the beds per 100,000 interaction term is positive and statistically significant, suggesting that prior to 1937, an increase of 100 beds per 100,000 population resulted in an increase of about 7 maternal deaths per 100,000 live births. These results are consistent with the conjecture that until the late 1930s obstetrical devotion to medical intervention rendered medical care detrimental to the health of women during the birthing process. The introduction of anti-infective sulfa drugs and improving obstetrics practices enabled obstetricians to prevent injury and combat infections induced by their medical interventions later in the 1930s.[18] The estimated coefficient for the pre-1937 variable indicates that maternal mortality was higher during the

[18] Sulfa drugs were effective against puerperal fever, but not as effective as antibiotics. City-level data are not reported beyond 1943, and antibiotics were not widely produced until 1946. However, state level data run for the period 1937-1950 (not reported here) show that penicillin had an even stronger impact on reducing maternal mortality after 1946.

early to mid 1930s than the rest of the period. Racial differences also appear to have played a role in maternal mortality; cities with larger black populations had higher levels of maternal mortality. The odd result in the balanced panel is the negative and statistically significant coefficient on the percent of the population that is illiterate. There is speculation in the historical literature that maternal mortality may have been higher among more educated, higher-income women exactly because of the fact that they tended to use hospitals for births, while less educated, lower-income women may have been less likely to deliver in hospitals.

Results for the unbalanced panel are somewhat different. The reason we use the balanced panel is because it may have been the case that cities added to the birth registration area later might have had higher rates of maternal mortality. This is consistent with the summary statistics presented in Table 2; the mean maternal mortality rate for the full sample is 627 deaths per 100,000 births, compared to 598 deaths per 100,000 births. To a large extent, the cities added later were in the South, where hospital quality may have been more dubious than in northern cities, and where blacks in particular had a more difficult time obtaining access to hospitals. Thus, it may not be surprising that the estimated coefficient on beds per 100,000 is not statistically significant. However, the interaction term is again positive and statistically significant, suggesting that prior to 1937 medical care may have hindered maternal mortality more than it helped.

We also estimate separate regressions by race over the same period to gauge whether medical care had a differential impact on blacks and whites.[19] Blacks, particularly in the South, may have had difficulty gaining access to quality medical care. Black women may have preferred to use black physicians, who were often excluded from good medical schools and residencies, and denied privileges at all but black hospitals or hospitals for the indigent, many of which were unable to keep up with rapidly advancing medical technologies (Smith 1999, p. 21). Even if blacks did not prefer to be attended by black

[19] The number of observations in the race regressions is significantly lower than for the regressions based on the total population as mortality and birth data were only provided for cities in which the minority population was greater than 10,000 or 10% of the total population. Also, mortality data by cause of death was not reported by race at the city level in 1938.

physicians, they may have been excluded from other hospitals or restricted to segregated facilities that offered lower quality care, especially in Southern cities (Almond, Chay and Greenstone 2001). If blacks were restricted in their access of medical care, or if they received substandard care, we would expect to see a differential effect of medical care on black maternal mortality relative to white maternal mortality.

Summary statistics by race are provided in Tables 4 and 5. Estimates from the race regressions are provided in Tables 6 and 7. Overall, results are consistent with those reported in Table 3, suggesting that hospitals had an adverse impact on maternal mortality for both blacks and whites prior to the advent of sulfa drugs. There is however, a differential effect of medical care for blacks compared to whites. Results from both the unbalanced and balanced panels show that the estimated coefficient on the beds*pre-1937 interaction term is much larger for blacks than whites, which is consistent with the hypothesis that blacks received lower quality care. Also consistent with this hypothesis is the estimated coefficient on hospital beds per 100,000. For white mothers, improvements in obstetrics practice and the use of sulfa drugs lowers maternal mortality; an increase in hospital beds per 100,000 after 1937 lowers maternal mortality by between 9.5 and 31 deaths per 100,000. For black mothers, medical care does not have a statistically significant effect on maternal mortality after 1937, suggesting that black mothers may have received a lower quality of care than white mothers.

5. Discussion

Despite the fact that hospital births increased dramatically over the period 1920 to 1950, maternal mortality rates did not decline until the mid-1930s when sulfa drugs were developed. This paper seeks to understand the relationship between medical care and maternal mortality. Did maternal mortality rates remain flat and even increase because of iatrogenic causes? If so, why did women increasingly seek hospital births for their children? Results based on a sample of city-level data from 1927-1940 provide support for the hypothesis that medical intervention prior to the advent of sulfa drugs in 1937 increased maternal mortality rates. From 1927-1936 the number of hospital beds per 100,000 people in a city seems to have increased maternal mortality, albeit very slightly. However, the development of anti-infectives

such as sulfa drugs did enable doctors to save mothers' lives in childbirth. In a sense, these drugs made medical care more effective by not only directly reducing deaths from puerperal fever, but also by enabling doctors to perform potentially life-saving procedures such as cesarean sections without the risk of subsequent life-threatening infections.

Regressions estimated separately by race reinforce the overall results that medical care increased maternal mortality prior to 1937, but also suggest that the impact of medical care on maternal mortality differed for blacks and whites. Relative to whites, hospitals posed a greater risk for black mothers prior to the availability of sulfa drugs in 1937, and were less beneficial for them afterwards, suggesting that blacks received lower quality medical care.

If medical care did not contribute to reducing maternal mortality, why did women increasingly turn to hospitals for childbirth? We can only speculate as to the reasons why the shift occurred, but it appears that women's preferences for anesthesia and physician preferences for convenience and higher incomes played a significant role. In addition, it may be very likely that women were not aware of the increased risk. Overall, hospitals increased maternal mortality in the late 1920s and early 1930s by only 10 deaths per 100,000 births, a number that few women may have noticed and may have been willing to overlook given the lack of alternatives and the comfort and convenience offered by hospital birth.

DATA APPENDIX

Data on maternal deaths and number of live births were obtained from reports on vital statistics published annually by the U.S. Bureau of the Census. These reports provided data at the city level for each city with a population of at least 10,000. There were 941 cities consistently represented in these reports. The maternal mortality variable was constructed by dividing maternal deaths by live births and multiplying by 100,000. This variable was used as the dependent variable in all regressions.

The American Medical Association's annual report on "Hospital Service in the United States" provided a listing of hospital beds by city. From this report an annual count of hospital beds could be obtained for each city. City populations for 1920, 1930, and 1940 were obtained from the Fourteenth, Fifteenth, and Sixteenth U.S. population censuses. Populations for all other years were calculated using a straight line interpolation between the two closest census years. The hospital beds and city population data were utilized to construct a hospital beds per 100,000 population variable. This variable was included in the regressions as an explanatory variable representing medical inputs.

Socioeconomic variables were constructed based on county level census data. Percent black, percent illiterate, and percentages of females in different age groups were calculated for 1920, 1930, and 1940. Straight line interpolation was used to obtain values for all other years. The percent black variable was created based on population data obtained from Historical, Demographic, Economic, and Social Data: The United States, 1790-1970, ICPSR file 0003, as corrected by Michael Haines. The percent female variables represent the number of females in each age group as a percent of the female population from 15 to 44 years of age. These variables were calculated from data provided in Gardner and Cohen's ICPSR file 0020 and the Fourteenth U.S. population census. For 1920 and 1930, the percent illiterate variable was calculated as the percentage of the population aged 10 and older that was illiterate. This data was captured in the 1920 and 1930 censuses and reported in ICPSR file 0003 as corrected by Michael Haines. However, beginning in 1940 the illiteracy counts were replaced in the census by years of schooling completed for people over 24 years old. We were able to combine this data with illiteracy data by age group and level of education for the entire U.S., obtained from the U.S. Bureau of the Census (1948, 7), to calculate percent illiterate for 1940. This process involved computing separate national illiteracy rates for males and females over 24 years old with no schooling (78.2% and 80.7% respectively) and males and females over 24 years old with one to four years of schooling (22.5% and 16.7% respectively). Applying these percentages to the census figures for the population aged 25 and older by sex and years of schooling provided a count of illiteracy from which we could calculate the percent illiterate. This is the same method utilized by Thomasson (2002) and Fishback et al. (2001).

The last socioeconomic variable included in the regressions was real retail sales per capita. This variable was constructed from county level data on population and retail sales. Population data for 1920, 1930, 1940, and 1950 was obtained from ICPSR file 0003 as corrected by Michael Haines. We used straight line interpolation to obtain population counts for 1929, 1933, 1935, 1939, and 1948. These were the only years in which retail sales information was available. Retail sales data for 1929 and 1939 were obtained from ICPSR file 0003 as corrected by Michael Haines. For 1933 and 1935 the data were acquired from the U.S. Department of Commerce, Bureau of Foreign and Domestic Commerce, 1936 and 1939. Lastly, 1948 retail sales figures were pulled from the City and County Data Book Consolidated File, County Data 1947-1977, ICPSR file 7736. The retail sales per capita variable was calculated directly for these years and was interpolated for all other years. The interpolation procedure involved a weighting mechanism based on changes in per capita state income. This was included to reflect the likelihood that retail sales per capita was closely linked to general economic performance. This variable was also adjusted for inflation.

REFERENCES

Almond, Douglas V., Kenneth Y. Chay, and Michael Greenstone. "Civil Rights, the War on Poverty, and Black-White Convergence in Infant Mortality Rates in Mississippi." Working paper, August 2001.

American Medical Association, Council on Medical Education. *Hospital Service in the United States*, various issues. Chicago: American Medical Association.

Beardsley, Edward H. *A History of Neglect: Health Care for Blacks and Mill Workers in the Twentieth-Century South*. Knoxville, TN: University of Tennessee Press, 1987.

Berger, Mark C. and J. Paul Leigh. "Schooling, Self-Selection, and Health." *Journal of Human Resources* 24, 3 (1989), 433-455.

Burrow, James G. *AMA: Voice of American Medicine*. Baltimore: The Johns Hopkins Press, 1963.

Chapin, Charles V. "The Control of Midwifery." *Medical Progress*, 39 (1923): 76-79.

Cunningham, F. Gary, Paul C. MacDonald, Norman F. Gant, Kenneth J. Leveno, Larry C. Gilstrap III, Gardy D.V. Hankins and Steven L. Clark. *Williams Obstetrics*, 20th Edition. Stamford, CT: Appleton & Lange, 1997.

De Lee, Joseph B. "The Prophylactic Forceps Operation." *American Journal of Obstetrics and Gynecology*, 1 (October, 1920): 34-44.

Dye, Nancy Schrom. "Mary Breckinridge, The Frontier Nursing Service and the Introduction of Nurse-Midwifery in the United States." Bulletin of the History of Medicine 57, 4 (Winter 1983): 485-507.

Edgar, J. Clifton. "The Remedy for the Midwife Problem." *American Journal of Obstetrics and Diseases of Women and Children*, 63 (1911): 881-884.

Fishback, Price V., William C. Horrace and Shawn Everett Kantor. "The Impact of New Deal Expenditures on Local Economic Activity: An Examination of Retail Sales, 1929-1939." National Bureau of Economic Research Working Paper #W8108, 2001.

Gardner, John, and William Cohen, "Demographic Characteristics of the Population of the United States, 1930-1950: County-Level," ICPSR file 0020, 1992.

Goddard, Jeanne C. *Medical and Nursing Services for the Maternal Cases of the National Health Survey*. U.S. Public Health Bulletin No. 264. Washington, Government Printing Office, 1941.

Gruber, Jonathan and Maria Owings. "Physician Financial Incentives and Cesarean Section Delivery." *RAND Journal of Economics* 27, 1 (Spring 1996): 99-123.

Inter-University Consortium for Political and Social Research, *Historical, Demographic, Economic, and Social Data: The United States, 1790-1970*, ICPSR file 0003. Computerized data tapes from ICPSR. The version has corrections by Michael Haines, Department of Economics, Colgate University, Hamilton, NY.

Kenkel, Donald S. "Health Behavior, Health Knowledge, and Schooling." *Journal of Political Economy* 99, 2 (1991): 287-305.

Ladies Home Journal, various issues, 1930-1932.

Leavitt, Judith Walter. *Brought to Bed*. New York: Oxford University Press, 1986.

Linder, Forrest E. and Robert D. Grove. *Vital Statistics Rates in the United States, 1900-1940*. Washington, D.C. Government Printing Office, 1943.

Litoff, Judy Barrett. *American Midwives, 1860 to the Present*. Westport, Connecticut: Greenwood Press, 1978.

Litoff, Judy Barrett. *The American Midwife Debate*. NewYork: Greenwood Press, 1986.

Lobenstine, Ralph Waldo. "The Influence of the Midwife upon Infant and Maternal Morbidity and Mortality." *American Journal of Obstetrics and Diseases of Women and Children* 63 (1911): 876-880.

Loudon, Irvine. "On Maternal and Infant Mortality 1900-1960." *Social History of Medicine*, 4, (1991): 29-73.

Loudon, Irvine. *Death in Childbirth: An International Study of Maternal Care and Maternal Mortality 1800-1950*. Oxford: Clarendon Press, 1992.

Markowitz, Gerald E. and David Karl Rosner. "Doctors in Crisis: A Study of the Use of Medical Education Reform to Establish Modern Professional Elitism in Medicine." *American Quarterly*, 25 (March 1973): 83-107.

Meara, Ellen. "Why Is Health Related to Socioeconomic Status? The Case of Pregnancy and Low Birth Weight." NBER Working Paper 8231 (2001).

Meigs, Grace L. *Maternal Mortality From All Conditions Connected with Childribth in the United States and Certain Other Countries*. U.S. Department of Labor Children's Bureau, Miscellaneous Series No. 6, Bureau Publication No. 19. Washington, D.C.: Government Printing Office, 1917.

New York Academy of Medicine Committee on Public Health Relations. *Maternal Mortality in New York City: A Study of all Puerperal Deaths, 1930-1932*. New York: Commonwealth Fund, 1933.

Radcliffe, Walter. *Milestones in Midwifery*. Bristol: John Wright & Sons Ltd., 1967.

Rochester, Anna. *Infant Mortality: Results of a Field Study in Baltimore, MD Based on Births in One Year*. U.S. Children's Bureau Publication No. 119. Washington, D.C.: Government Printing Office, 1923.

Rosenberg, Charles E. *The Care of Strangers*. New York: Basic Books, 1987.

Rushman, G.B., N.J.H. Davies, R.S. Atkinson. *A Short History of Anesthesia: The First 150 Years*. Oxford: Butterworth-Heinemann, 1996.

Sandelowski, Margarete. *Pain, Pleasure and American Childbirth: From the Twilight Sleep to the Read Method, 1914-1960*. Westport, Connecticut: Greenwood Press, 1984.

Smith, David Barton. *Health Care Divided: Race and Healing a Nation*. Ann Arbor: The University of Michigan Press, 1999.

Starr , Paul. *The Social Transformation of American Medicine*. New York: Basic Books, 1982.

Stevens, Rosemary. *American Medicine and the Public Interest*. New Haven and London: Yale University Press, 1971.

Stevens, Rosemary. *In Sickness and in Wealth: American Hospitals in the Twentieth Century*. New York: Basic Books, 1989.

Tandy, Elizabeth C. "Comparability of Maternal Mortality Rates in the United States and Certain Foreign Countries." U.S. Children's Bureau Publication No. 229. Washington: Government Printing Office, 1935.

Temin, Peter. "An Economic History of American Hospitals." *Health Care in America: The Political Economy of Hospitals and Health Insurance*. Ed. H.E. Frech. San Francisco: Pacific Research Institute for Public Policy, 1988. 75-102.

Thomasson, Melissa A. "From Sickness to Health: The Twentieth Century Development of U.S. Health Insurance." *Explorations in Economic History*, 39, 3 (July 2002): 233-53.

U.S. Bureau of the Census. *Birth, Stillbirth, and Infant Mortality Statistics for the Birth Registration Area of the United States*, various issues 1930-1932. Washington, D.C.: Government Printing Office.

U.S. Bureau of the Census. *Birth, Stillbirth, and Infant Mortality Statistics for the Continental United States, The Territory of Hawaii, and the Virgin Islands* various issues 1933-1936., Washington, D.C.: Government Printing Office.

U.S. Bureau of the Census, "County and City Data Book Consolidated File, County Data 1947-1977," [machine-readable data file] Washington: The Bureau, 1978. ICPSR file 7736, 1999.

U.S. Bureau of the Census, "Illiteracy in the United States, October 1947," *Current Population Reports: Population Characteristics*, Series P-20 no. 20, September 22, 1948.

U.S. Bureau of the Census, "School Enrollment, Educational Attainment, and Illiteracy, October 1952," *Current Population Reports: Population Characteristics*, Series P-20 no. 45, October 22, 1953.

U.S. Bureau of the Census, "Special Reports: Occupations of the Twelfth Census." Washington, D.C.: Government Printing Office, 1904.

U.S. Bureau of the Census. *Vital Statistics of the United States* various issues 1937-1943., Washington, D.C.: Government Printing Office.

U.S. Bureau of the Census, *Fourteenth Census of the United States: Population, Volumes I & II.* Washington DC: Govt. Printing Office, 1921.

U.S. Bureau of the Census, *Fifteenth Census of the United States: Population, Volume VI, Families.* Washington DC: Govt. Printing Office, 1933.

U.S. Bureau of the Census, *Sixteenth Census of the United States: Population, Volume I, Number of Inhabitants.* Washington DC: Govt. Printing Office, 1942.

U.S. Bureau of the Census, *Seventeenth Census of the United States: Population, Volume II, Parts 2-50, Characteristic of Population.* Washington DC: Govt. Printing Office, 1952.

U.S. Bureau of Economic Analysis, *State Personal Income: 1929-1987.* Washington, DC: Government Printing Office, 1989.

Wertz, Richard W., and Dorothy C. Wertz. *Lying-In: A History of Childbirth in America.* New Haven and London: Yale University Press. 1989.

Woodbury, Robert Morse. *Causal Factors in Infant Mortality: A Statistical Study Based on Investigations in Eight Cities.* U.S. Children's Bureau Publication No. 142. Washington: Government Printing Office, 1925.

Vogel, Morris J. *The Invention of the Modern Hospital, Boston, 1870-1930.* Chicago: The University of Chicago Press, 1980.

White House Conference on Child Health and Protection. *Fetal, Newborn and Maternal Morbidity and Mortality.* New York and London: D. Appleton-Century Company, 1933.

Table 1a: Birth Attendant, by Place of Birth and by Earnings of Father, Baltimore, 1915

Earnings of Father	Percent Attended by Physician		Midwife	Other
	In hospital	Outside hospital		
None	26.3	51.7	20.7	1.3
Less than $850	7.9	52.7	39.1	0.2
$850-$1,849	9.1	68.7	22.0	0.8
$1,850 and over	25.9	67.5	6.6	0.0

Source: Rochester 1923, Appendix VI, Table VI, p. 212.

Table 1b: Birth Attendant, by Nationality of Mother, Baltimore, 1915

Race and Nationality of Mother	Percent Attended by Physician		Midwife	Other
	In hospital	Outside hospital		
Native, white	8.1	64.4	27.4	0.2
Jewish	23.8	41.1	35.0	0.1
Polish	2.9	18.9	77.6	0.6
Italian	2.3	52.4	44.8	0.5
Other foreign born, white	5.9	50.6	42.8	0.6
Nonwhite	13.5	60.4	25.9	0.2

Source: Rochester 1923, Appendix VI, Table VII, p. 213.

Table 2: Summary Statistics

ALL OBSERVATIONS

Variable	Mean	Std. Dev.	Min	Max
Maternal Mortality Rate	627.18	389.55	0.00	100000.00
Hospital Beds Per 100,000 Population	537.47	350.20	0.00	7258.77
% Black	7.47	9.86	0.00	77.40
% Illiterate	3.68	2.09	0.30	36.99
Real Retail Sales Per Capita	0.89	0.23	0.14	1.92
% Females 15-19	17.52	2.02	12.90	28.21
% Females 20-24	18.47	1.00	14.37	24.29
% Females 25-34	34.29	1.49	27.16	42.10

Notes: 10,279 observations. Summary statistics weighted by total births. The maternal mortality rate is calculated as the number of deaths from puerperal causes per 100,000 live births.

BALANCED PANEL

Variable	Mean	Std. Dev.	Min	Max
Maternal Mortality Rate	598.25	282.27	0.00	9523.81
Hospital Beds Per 100,000 Population	509.57	200.71	0.00	3013.79
% Black	6.45	7.45	0.00	45.75
% Illiterate	3.59	1.69	0.48	9.93
Real Retail Sales Per Capita	0.92	0.21	0.36	1.63
% Females 15-19	17.13	1.67	12.90	24.62
% Females 20-24	18.37	0.86	15.91	24.29
% Females 25-34	34.49	1.34	28.31	37.98

Notes: 3,668 observations. Summary statistics weighted by total births. The maternal mortality rate is calculated as the number of deaths from puerperal causes per 100,000 live births.

Table 3: Maternal Mortality Regressions, 1927-1940
(Total Population)

Variable	Est. Coefficient (Std. Error)	Est. Coefficient (Std. Error)
Hospital Beds Per 100K	-0.105 [b]	-0.011
	(0.043)	(0.014)
(Hospital Beds Per 100K)*Pre-1937	0.177 [a]	0.117 [a]
	(0.051)	(0.022)
Pre-1937 Dummy	182.950 [a]	233.010 [a]
	(30.648)	(16.241)
Percent Black	7.173 [a]	9.822 [a]
	(1.964)	(1.281)
Percent Illiterate	-13.816 [a]	-3.911
	(5.236)	(3.973)
Real Retail Sales Per Cap	23.874	33.339
	(29.176)	(25.894)
% Females ages 15-19	28.987 [a]	26.637 [a]
	(9.182)	(6.572)
% Females ages 20-24	30.853 [a]	33.738 [a]
	(8.985)	(6.654)
% Females ages 25-34	-20.775 [b]	-34.955 [a]
	(9.523)	(7.341)
Constant	-77.206	250.194
	(442.965)	(334.510)
State Dummies	Yes	Yes
Balanced Panel	Yes	No
R^2	0.4934	0.3956
# of observations	3,668	10,279

Notes: Dependent variable is the total maternal mortality rate, defined as number of maternal deaths/total births per 100,000 births. Excluded state dummy is Connecticut in both regressions. Regressions are weighted by total births.
a: Significant at the 1% level
b: Significant at the 5% level
c: Significant at the 10% level

Table 4: Summary Statistics
(white population)

ALL OBSERVATIONS

Variable	Mean	Std. Dev.	Min	Max
Maternal Mortality Rate	583.79	314.47	0.00	14285.71
Hospital Beds Per 100,000 Population	516.85	212.13	0.00	4255.74
% Black	10.25	9.98	0.20	77.40
% Illiterate	4.07	1.97	0.75	36.99
Real Retail Sales Per Capita	0.94	0.23	0.14	1.63
% Females 15-19	16.68	1.65	12.90	28.21
% Females 20-24	18.54	1.01	15.91	24.29
% Females 25-34	35.01	1.18	27.16	42.10

Notes: 1,960 observations. Summary statistics weighted by white births. The maternal mortality rate is calculated as the number of deaths from puerperal causes per 100,000 live births.

BALANCED PANEL

Variable	Mean	Std. Dev.	Min	Max
Maternal Mortality Rate	553.92	224.56	0.00	14285.71
Hospital Beds Per 100,000 Population	490.21	138.35	179.28	2809.78
% Black	9.30	7.55	2.28	45.75
% Illiterate	4.15	1.43	1.16	9.93
Real Retail Sales Per Capita	0.97	0.20	0.36	1.63
% Females 15-19	16.49	1.05	13.55	21.76
% Females 20-24	18.54	0.77	16.56	24.29
% Females 25-34	35.15	0.95	30.88	37.98

Notes: 468 observations. Summary statistics weighted by white births. The maternal mortality rate is calculated as the number of deaths from puerperal causes per 100,000 live births.

Table 5: Summary Statistics
(non-white population)

ALL OBSERVATIONS

Variable	Mean	Std. Dev.	Min	Max
Maternal Mortality Rate	1188.23	875.47	0.00	50000.00
Hospital Beds Per 100,000 Population	569.53	259.40	0.00	4255.74
% Black	19.81	15.17	0.20	77.40
% Illiterate	4.89	2.98	0.75	36.99
Real Retail Sales Per Capita	0.85	0.25	0.14	1.63
% Females 15-19	17.22	2.07	12.90	28.21
% Females 20-24	18.97	1.28	15.91	24.29
% Females 25-34	34.82	1.35	27.16	42.10

Notes: 1,959 observations. Summary statistics weighted by nonwhite births. The maternal mortality rate is calculated as the number of deaths from puerperal causes per 100,000 live births.

BALANCED PANEL

Variable	Mean	Std. Dev.	Min	Max
Maternal Mortality Rate	1074.34	527.75	0.00	4761.91
Hospital Beds Per 100,000 Population	536.73	175.29	179.28	2809.78
% Black	16.10	12.10	2.28	45.75
% Illiterate	4.39	1.69	1.16	9.93
Real Retail Sales Per Capita	0.89	0.20	0.36	1.63
% Females 15-19	16.79	1.14	13.55	21.76
% Females 20-24	18.79	1.05	16.56	24.29
% Females 25-34	35.08	0.89	30.88	37.98

Notes: 468 observations. Summary statistics weighted by nonwhite births. The maternal mortality rate is calculated as the number of deaths from puerperal causes per 100,000 live births.

Table 6: Maternal Mortality Regressions, 1927-1940

(White Population)

Variable	Est. Coefficient (Std. Error)	Est. Coefficient (Std. Error)
Hospital Beds Per 100K	-0.390 [a]	-0.105 [b]
	(0.142)	(0.048)
(Hospital Beds Per 100K)*Pre-1937	0.492 [a]	0.195 [a]
	(0.137)	(0.058)
Pre-1937 Dummy	-35.985	146.988 [a]
	(75.597)	(39.398)
Percent Black	5.177 [c]	4.130 [b]
	(2.936)	(1.666)
Percent Illiterate	-1.998	-0.805
	(10.511)	(6.468)
Real Retail Sales Per Cap	64.093	61.903
	(58.146)	(44.176)
% Females ages 15-19	31.915	25.649 [c]
	(24.892)	(13.894)
% Females ages 20-24	58.847 [a]	39.219 [a]
	(16.152)	(11.686)
% Females ages 25-34	9.841	-36.848 [b]
	(27.014)	(16.851)
Constant	-1,424.659	444.294
	(1,163.689)	(762.559)
State Dummies	Yes	Yes
Balanced Panel	Yes	No
R^2	0.6162	0.4448
# of observations	468	1,960

Notes: Dependent variable is the total maternal mortality rate, defined as number of maternal deaths/total births per 100,000 births. Excluded state dummy is Connecticut in both regressions. Regressions weighted by total white births.

a: Significant at the 1% level

b: Significant at the 5% level

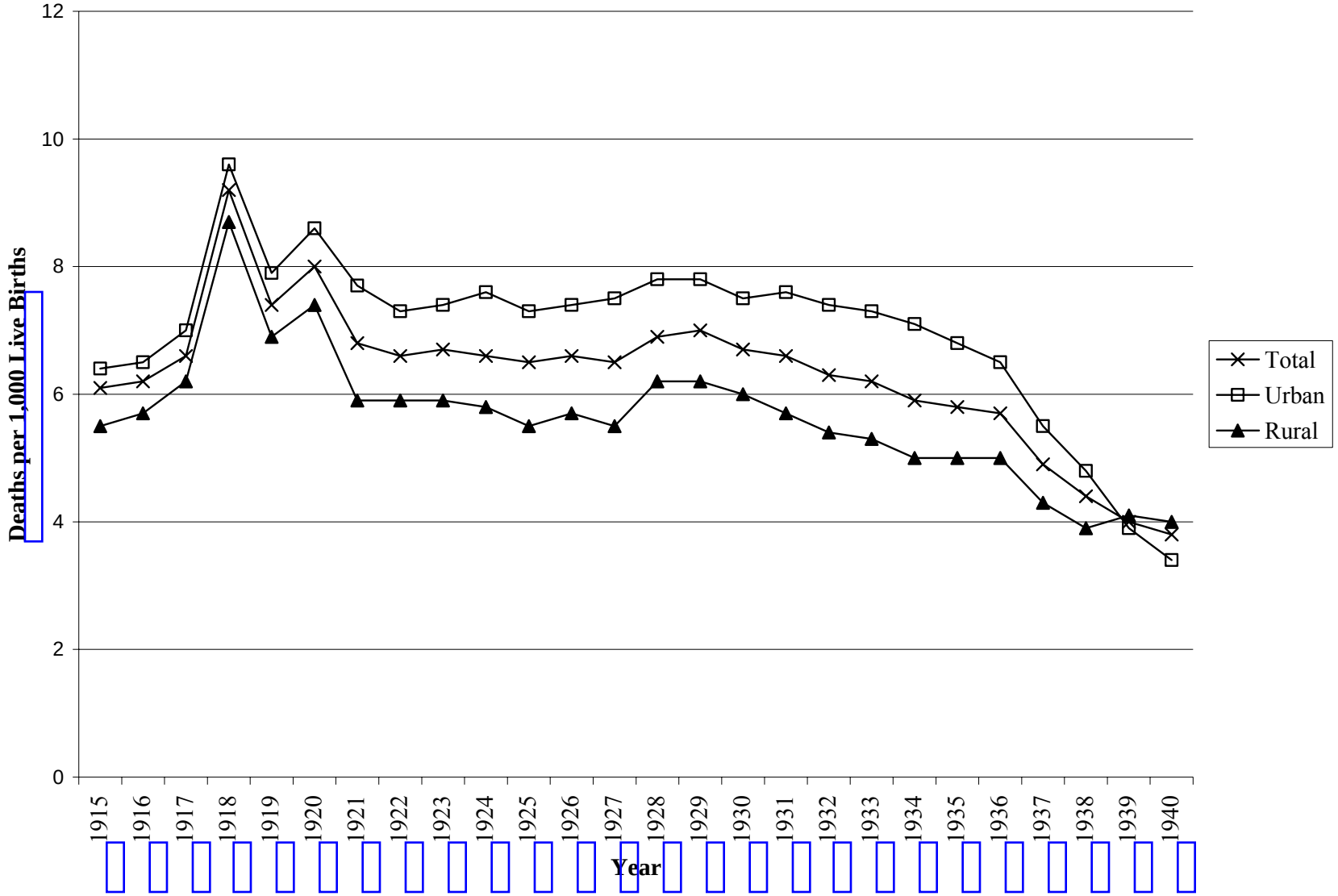
c: Significant at the 10% level

Table 7: Maternal Mortality Regressions, 1927-1940
(Non-White Population)

Variable	Est. Coefficient (Std. Error)	Est. Coefficient (Std. Error)
Hospital Beds Per 100K	-0.447	0.070
	(0.341)	(0.136)
(Hospital Beds Per 100K)*Pre-1937	1.088 [a]	0.554 [a]
	(0.330)	(0.188)
Pre-1937 Dummy	-137.448	120.675
	(181.163)	(104.276)
Percent Black	17.003 [a]	17.207 [a]
	(6.128)	(3.444)
Percent Illiterate	60.755 [b]	-7.732
	(26.013)	(12.267)
Real Retail Sales Per Cap	422.332 [a]	369.987 [a]
	(134.475)	(123.150)
% Females ages 15-19	140.689 [b]	144.025 [a]
	(55.196)	(38.935)
% Females ages 20-24	27.339	51.961 [c]
	(38.712)	(29.806)
% Females ages 25-34	65.885	-3.820
	(63.934)	(51.630)
Constant	-5,262.002 [c]	-3,373.066
	(2,857.644)	(2,334.672)
State Dummies	Yes	Yes
Balanced Panel	Yes	No
R^2	0.5288	0.3118
# of observations	468	1,959

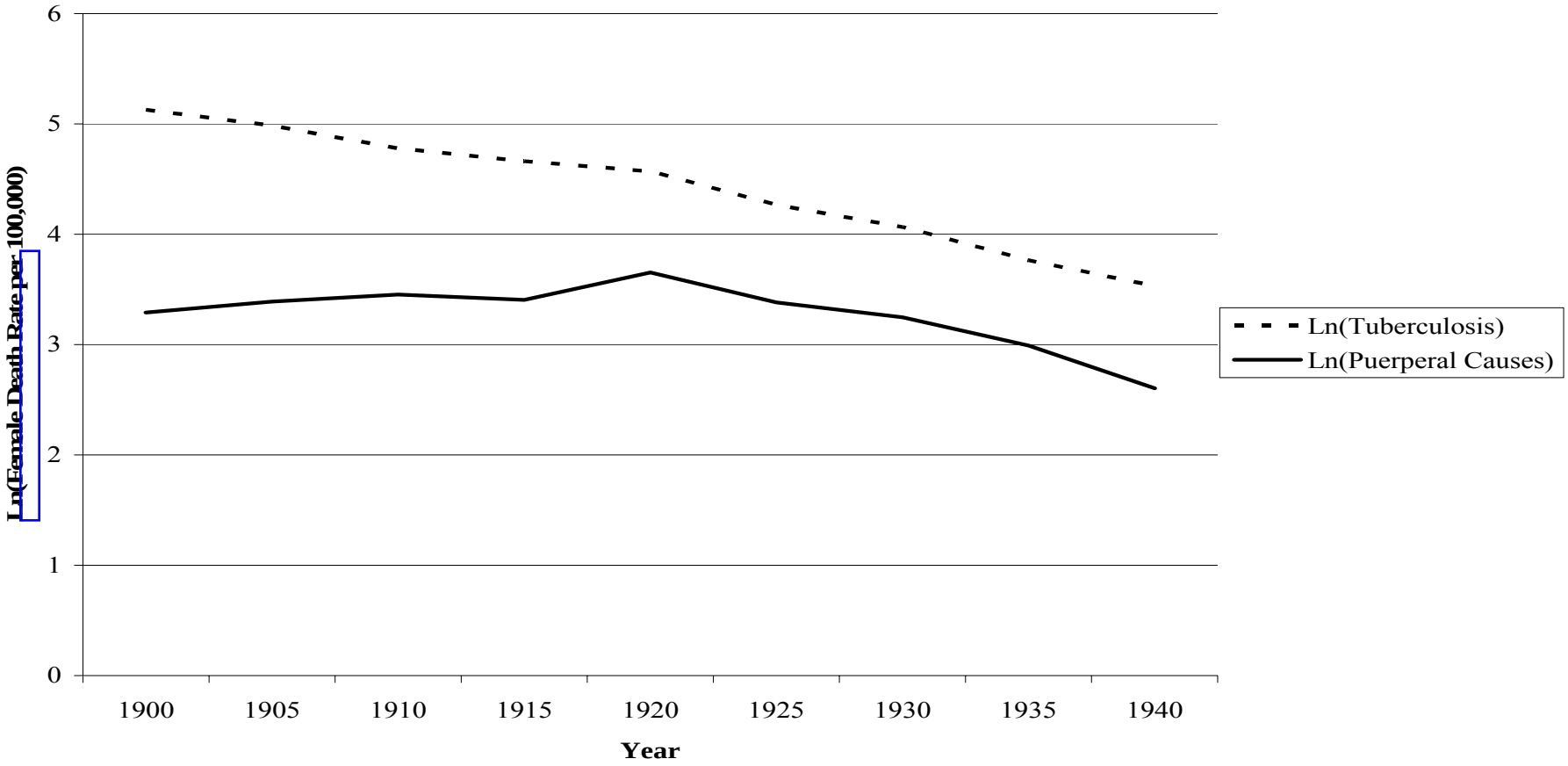
Notes: Dependent variable is the total maternal mortality rate, defined as number of maternal deaths/total births per 100,000 births. Excluded state dummy is Connecticut in both regressions. Regression weighted by total nonwhite births.
a: Significant at the 1% level
b: Significant at the 5% level
c: Significant at the 10% level

Figure 1: Maternal Mortality: Birth Registration States, 1915-1940



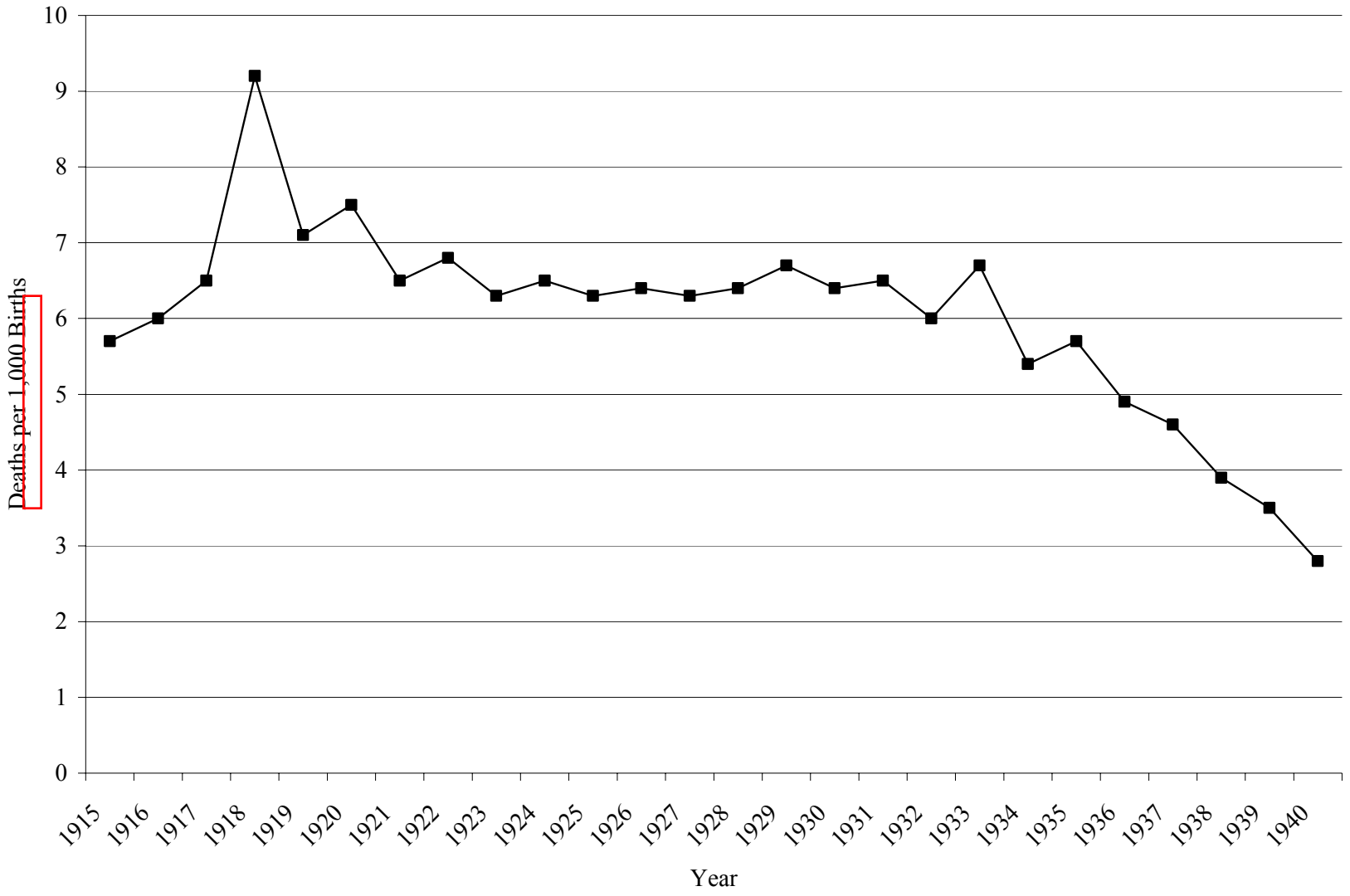
Source: Linder and Grove (1943). *Vital Statistics Rates in the United States, 1900-1940*, Table 37, p. 622.

Figure 2: Death Rates Among Females due to Tuberculosis v. All Puerperal Causes, Death Registration States: 1900-1940



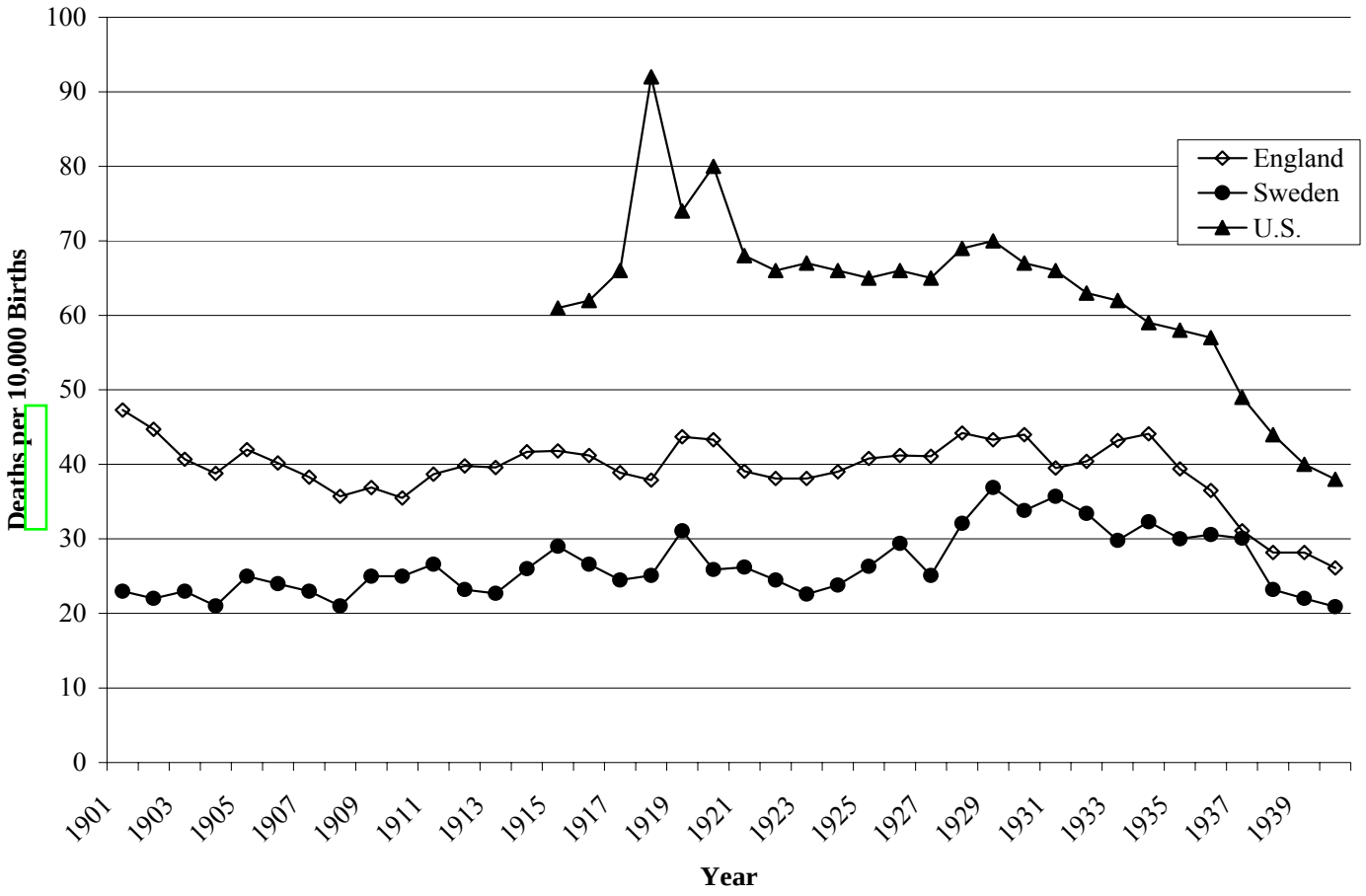
Source: Linder and Grove (1943). *Vital Statistics Rates in the United States, 1900-1940*, Table 15, pp. 258-253

Figure 3: Maternal Mortality in Massachusetts, 1915-1940



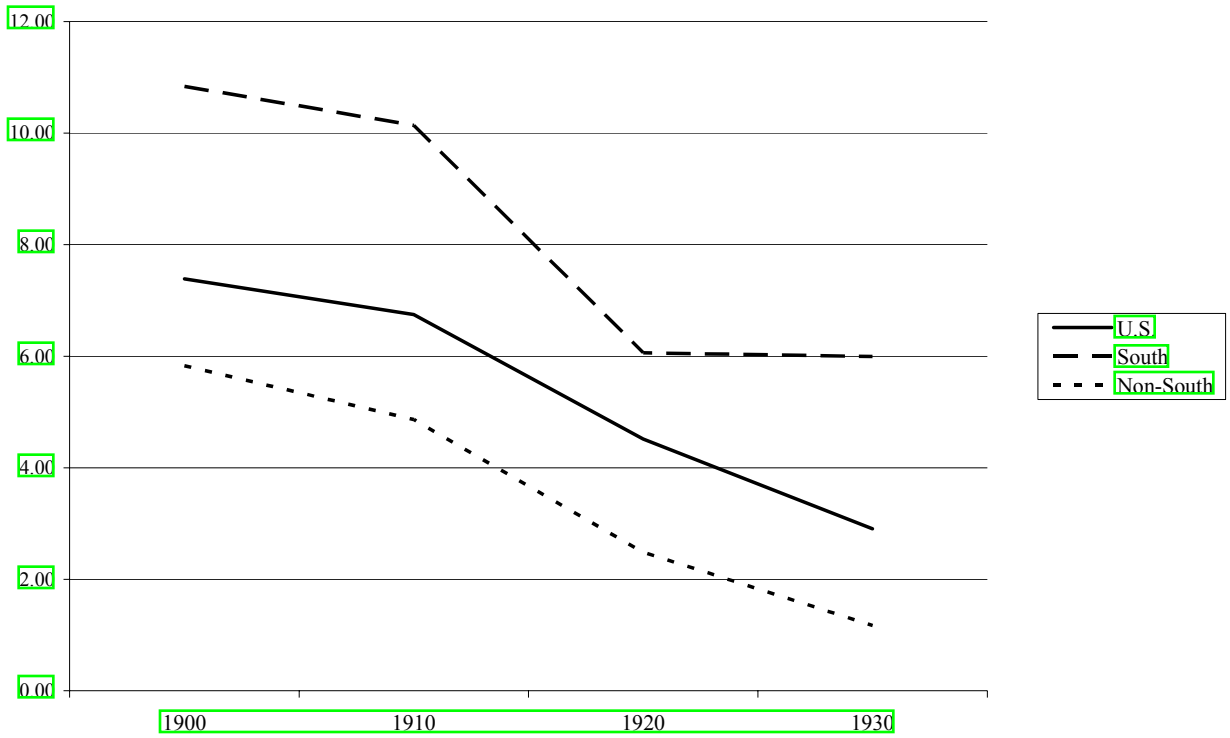
Source: Linder and Grove (1943). *Vital Statistics Rates in the United States*, 1900-1940, Table 36

Figure 4: International Maternal Mortality



Source: U.S. data are from Linder and Grove (1943), *Vital Statistics of the United States, 1900-1940*, Table 36, "Maternal Mortality: Birth Registration States, 1915-1940." Data for England and Sweden are from Loudon (1992), Appendix 6, Table 1 and 7

Figure 5: Midwives per 100,000 Population: 1900-1930



Source: Data are from the U.S. Bureau of the Census. 1900: U.S. Bureau of the Census Special Reports: Occupations in the Twelfth Census. Tables 33 and 42. 1910: Thirteenth Census of the United States, Volume IV: Population: Occupation Statistics. Tables II, II, IV. 1920: Fourteenth Census of the United States. Volume IV: Population: Occupations. Tables 15, 19, 20. 1930: Fifteenth Census of the United States. Volume IV: Population: Occupations, by States. Tables 4 and 5.