The Gendered Effects of the Civil War Cotton Famine: Evidence from Massachusetts Textile Towns*

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Abstract

The Civil War created a raw cotton shortage that plunged the North's prominent textile industry into crisis. This paper uses newly-digitized state and federal manufacturing censuses to investigate how this supply shock affected Massachusetts towns specializing in cotton textile production, where, notably, women were the majority of the manufacturing workforce. Adopting a differences-in-differences identification strategy, I find that female employment dropped substantially in "cotton towns" during the war while male employment and total manufacturing output were unaffected. Effects were short-lived as both female employment and the broader cotton textiles industry recovered within ten years. I argue using a mix of causal, descriptive, and historical evidence that the high turnover, migratory nature of the labor supply in Massachusetts's cotton textiles industry explains its resilience to the Civil War shock. Companies had extensive prewar experience in continually recruiting young women from across New England to come work in their mills, so they were well-positioned to, and did, hire a new generation once the raw cotton supply returned postwar.

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1 Introduction

Cotton textiles was the United States's biggest antebellum manufacturing industry, and with a majority female workforce, it was the largest market employer of women (U.S. Census Bureau, 1865). Before the Civil War, production concentrated in mill towns such as Lowell, Massachusetts, which relied on the increasing flow of raw cotton from southern plantations. The war's outbreak in 1861 and concomitant collapse of raw cotton production shattered this supply chain, temporarily shuttering most cotton textile factories and leaving the workers in mill towns—especially young women—without work. The shock proved to be short-lived, however, as despite the abolition of slavery, the South's cotton output quickly returned to its prewar levels by the mid 1870s.

This paper studies the effects of this massive, negative, and ultimately temporary shock to the supply of raw cotton for textile production in Massachusetts during the American Civil War. To do so, I construct a novel town-level panel dataset covering the period 1837 to 1895 that combines newly-digitized state censuses with Massachusetts's establishment-level returns from the complete-count federal censuses of manufactures (Hornbeck et al., 2025). Using an event study design, I estimate immediate and postwar effects by comparing manufacturing outcomes during and after the Civil War between Massachusetts towns with more than 20 percent of antebellum employment in cotton goods—which I refer to as cotton towns—and non-cotton towns.

I find that the effects of the shock varied by gender but were temporary. Due to the composition of the cotton textiles workforce, the wartime supply shortage caused female employment to drop by 87 log points (58%) in 1865 in cotton towns while leaving male employment and manufacturing output untouched. The effect on female employment dissipated by 1875, and the effects on male and total employment as well as output in postbellum years were large and positive, though often statistically insignificant.

I then turn to investigating the effects across the state on the cotton textiles industry. It is possible, for instance, that postwar industry diversification could explain the immediate recovery but mask lingering effects on the industry experiencing the supply shock. To explore this possibility, I use town-industry-year data from the manufacturing censuses and a differences-in-differences approach in which I compare outcomes between the cotton goods industry and the other industries in the state. I again find temporary effects on employment, which declined relative to other industries during the Civil War but recovered by 1875.

I end by demonstrating that an existing institutional feature of cotton textiles production in

Massachusetts, its high turnover, migratory labor force, contributed to the resilience to the Civil War supply shock. While limitations on the availability and quality of individual-level data on women with antebellum market employment prevent me from answering the most pressing questions directly—namely, did the same women return to the mills, and if not, where did the next generation of female operatives come from—I am still able to glean insights from a variety of sources. First, I juxtapose the Massachusetts experience with Britain's, whose cotton textiles industry relied on "permanent factory population" for its labor supply (Dublin, 1993, p. 184) and saw persistent negative effects on population growth and mortality from the same shock (Hanlon, 2017; Arthi et al., 2022). In contrast, using my town-level differences-in-differences design and population counts from state and federal censuses, I find small positive effects on total, male, and female population sizes in the last year of the war, 1865, while all three grew substantially relative to non-cotton towns in the postbellum period. While this establishes there was, and continued to be, a large enough pool of labor to work in the mills once the cotton supply returned, I consider the questions of turnover and migration by examining the characteristics of female cotton textile workers in the 1870 Census. I show that almost two-thirds would have been too young to have worked in the mills when the war started, and the majority of those that could be linked back to the 1860 Census had migrated from out of town. I then highlight mill company records that corroborate that the recruitment of out-of-town, temporary workers resumed after the war.

This paper advances a seminal literature on the consequences of the American Civil War for the North's long-run development. Previous foundational work has examined how broad macroeconomic outcomes evolved during and following the war (Cochran, 1961; Engerman, 1966; Goldin and Lewis, 1975), concluding that the "the Civil War resulted in a brief pause in the [North's] long-run growth and development" (Atack and Passell, 1994, p. 376). Goldin and Lewis (1975) infer that per capita consumption returned to its prewar growth path by the end of the 1870s. My causally identified findings provide support this conclusion for towns specializing in cotton textiles production.

I also contribute to the broader literature on the economic history of the American Civil War, which has received renewed interest in recent years. This research investigates the effects of mobilizing and fighting the war (Khan, 2015; Hall et al., 2019; Dippel and Heblich, 2021; Feigenbaum et al., 2022), as well as its aftermath, including emancipation (Ager et al., 2021; Hornbeck and Logan, 2026), Reconstruction (Logan, 2020, 2023), the persistence of racial wealth disparities (Derenoncourt et al., 2023, 2024), and the origins of continued anti-Black violence into the 20th century (Esposito et al., 2023; Ang, 2023; Chyn et al., 2026). While evidently rich and varied in subject

and scope, none of this literature has considered the Civil War as a shock to trade and production processes.

Finally, I advance two strands of the historical literature on women's role in industrialization. The first broadly concerns trends in female labor force participation, employment, and occupational segregation and sorting originating in the nineteenth century (Goldin, 1980; Goldin and Sokoloff, 1982; Costa, 2000).[1] The second investigates the effects of large gender-biased economic shocks. Recently, Ager et al. (2026) and Feigenbaum and Gross (2024) have examined the consequences of automation shocks in heavily-female industries (cow-milking in Norway and telephone operation in the United States, respectively). Goehring (2025) concludes that the Civil War cotton famine increased the supply of sex work in British cotton textile counties during the war, but the effect dissipated by 1868. In line with these findings, I uncover a lack of negative persistence.

2 Historical Background

2.1 Manufacturing in Antebellum Massachusetts

Massachusetts was at the forefront of American industrialization in the 19th century, especially in cotton textiles. While the first American cotton mill opened in Beverly, Massachusetts in 1788, the industry took off in the 1820s[2] when production moved from the putting out system into the factory "where the processes of manufacture were all carried on under the same roof, the first instance of the kind in the United States" (Massachusetts Bureau of Statistics of Labor 1899, p. 219-221; Dublin 1994, p. 29-30, 33). The factory system brought gains from both mechanization and the organization of production (Atack et al., 2022). As Worthington (1827, p. 131) noted, "good machinery" and "labor...directed by a single experienced agent" had brought the price for weaving common cotton cloth from a range of five to 14 cents per yard in 1814 down to nine-tenths of a cent per yard and the price of cotton shirting from 50 cents to 16 cents.[3]

Data from early state industrial censuses highlight the expansion of textiles in antebellum Massachusetts (Commonwealth of Massachusetts, 1838, 1846, 1856).[4] In the 18-year period between

[1] Occupational segregation and sorting refer to the phenomenon whereby men and women have historically worked in different occupations, and in many cases continued to do so, due to discrimination, social norms, institutional and legal barriers, preferences, and so on (see Altonji and Blank (1999), Olivetti et al. (2024)).

[2] Davis and Irwin (2026) show that trade disruptions between 1807-1814 (the 1807 embargo, non-importation measures, and the War of 1812) boosted cotton textiles and other infant industries in the early United States.

[3] These are real declines of 2.84-7.96 cents to 0.9 cents and 28.4 cents to 16 cents, respectively (Lindert and Sutch, 2006, Table Cc2).

[4] See Section 3 for a detailed discussion of these data.

1837 and 1855, capital investment grew by 166%.[5] The number of cotton spindles in use, the amount of raw cotton consumed in production, and the number of yards of cotton cloth manufactured all more than doubled, with the bulk of the increase coming between 1845 and 1855. Labor productivity—measured as the number of yards of cotton cloth produced per worker—rose by 41.6%. As the scale of cotton production rose dramatically, it remained concentrated in the state's "mill towns". While 98 towns produced any amount of cotton goods in 1855, just four—Lowell, Lawrence, Fall River, and Chicopee—comprised roughly 60% of the state's output and capital, with Lowell alone responsible for 37% of output and 33% of capital. In 1860, on the eve of the Civil War, Massachusetts consumed 134 million pounds of raw cotton, 83 million more than any other state and just under 1/3 of all cotton used in American textiles production (U.S. Census Bureau, 1865).

The expansion of cotton textiles in Massachusetts required ever more operatives, and mills turned to the young women of New England to meet the need. Two distinct methods for securing labor supply developed, the "Waltham-Lowell" and "Slater" systems, and both shared a few essential attributes. First, as the bulk of the mechanized production process for converting baled cotton into finished textiles required little skill, strength, and dexterity, mostly women and children were hired (Dublin, 1993, p. 62-67).[6] In 1837, 18,788 mill hands worked in the manufacture of cotton goods, compared with 35,703 in 1855, an increase of 90%. Of these 35,703 workers, 64% were female, which was unique to the industry as women were the minority in the other areas where they tended to find employment (see figure 1).[7] Second, labor was scarce where the waterpower needed to power the mills was abundant, so companies were forced to "devise schemes for securing their workers" from out of town (Ware 1931, p. 198; Smith 1944, p. 36). Under the "Waltham-Lowell" system that dominated Massachusetts, mill owners created planned communities around their factories and recruited young, rural, native-born women to work by promising their fathers that they would live in closely-monitored boarding houses and send home part of their wages (Ware 1931, p. 200-201; Dublin 1993, Chap. 3, p. 75-77). While children as young as ten worked in the mills (Robinson, 1898, p. 40), the representative "mill girl" was unmarried and between the ages of 15-19 (Dublin, 1994, p. 88-89, 109-110, 112). In contrast, Slater-style mills in Rhode Island and southeastern

[5] In real terms, adjusting values from both years to 1860 dollars using consumer price indices from Lindert and Sutch (2006), Table Cc2.

[6] Specifically, carding and picking, which were the initial preparation stages, involved operating machinery that demanded strength and endurance.

[7] Woolen textile production was similar to that of cotton textiles, but an important difference was that "work generally was too arduous or required too much skill for the employment of women and children as responsible machine tenders." After the introduction of the power loom, women began to work in large numbers as weavers in woolen mills but still remained a minority (Cole, 1926, p. 237-239).

Massachusetts recruited entire families to "uproot...give up their homes and move to a factory town" where they often lived in tenements owned by the company (Ware 1931, p. 199, 213; Smith 1944, p. 75-76; Dublin 1993, p. 40). Finally, turnover was high regardless of variety of mill, and women only worked in the industry for a few years before leaving (Ware, 1931, p. 226).[8]

[Figure 1 about here]

2.2 King Cotton: Southern Agriculture

The industrial revolution taking place in Massachusetts would not have been possible without the South's increasing supply of raw cotton. Figure 2 plots the South's cotton output by year for the period 1790 to 1905. Between 1800 and 1860, cotton production increased by over 51 times, with an annual growth rate of 6.83%. For the specific period from 1837 to 1855, during which cotton used in production increased by 184% in Massachusetts, the South's output rose annually by 4.62% for 126% overall growth. Productivity gains in cotton planting came from the diffusion of the gang system of labor (Fogel and Engerman, 1974) as well as yield and quality improvements from the introduction of Mexican hybrid cotton varieties (Olmstead and Rhode, 2008). As a result, Olmstead and Rhode (2008) note that the cotton picked per enslaved person per day increased 2.3% annually from 1801 to 1862, for an overall increase of 4.1 times. Furthermore, such efficiency gains incentivized the westward expansion of cotton cultivation, which, compounded with the productivity increases, created the massive growth in output.

2.3 The Civil War Cotton Shock

The Civil War caused a major, but ultimately temporary supply shock to the cotton textiles industry.[9] There were two main contributing factors. The first was the steep decline in Southern cotton production. Figure 2 shows the massive drop-off in output immediately following the war's beginning in 1861. By 1864, cotton production had declined to the level observed in 1818, only 6.7% of the 1861 figure. Second, the Union Navy's blockade of Southern ports reduced the South's raw cotton exports to one-eighth of their prewar levels, and the corresponding increase in transportation

[8] Massachusetts's cotton textile labor force did evolve in the 1850s with the arrival of Irish famine immigrants to textile manufacturing towns, but these common characteristics remained (Dublin 1993, p. 147, 167; Dublin 1994).

[9] While other shocks hit Massachusetts's economy during the Civil War, such as the overall decrease in demand for manufactured goods due to the loss of the Southern market (Engerman, 1966) and the drop in labor supply as men went to the battlefields, this supply shock was unique in that towns' exposure varied tremendously throughout the state. As section 4.1 discusses, this variation allows me to identify the specific effects of the cotton textiles shock on manufacturing outcomes.

costs made any raw cotton that arrived in the North three to four times more expensive than it had been prewar (Surdam, 1999). Finally, while less significant than the other two factors, Southern planters purposefully destroyed around 50% of the remaining cotton bales "to prevent its falling into the hands of the enemy" (Lebergott, 1981).

[Figure 2 about here]

The wartime effects of the cotton famine were evident in Massachusetts. Within a year, many companies ran out of cotton (Layer, 1955, p. 31), and at least 1 million of the state's 1.5 million spindles were idle (Atkinson, 1863, p. 96). As supplies ran out, manufacturers accepted that "it will be a long time before the cultivation will be resumed under circumstances to produce such crops as we have had for a few years past," and "much reliance is placed...on supplies from other sources" (Batchelder, 1862, p. 125). There were attempts to substitute with Indian cotton which did not "result so unfavorably as had been expected" (Batchelder, 1862, p. 123); that said, foreign imports never came close to overcoming the shortage of American cotton.[10] In response, many cotton mills converted to making woolen goods for the Union army (Bond and Livermore, 1862, p. 128). Despite the substitutability of wool for cotton,

Surviving records of cotton textile mills demonstrate how severe the crisis had become in 1863. Using payroll and production data compiled by Layer (1951), figure 3 shows that cotton consumed in production, cotton cloth produced, and total labor costs at the Hamilton Manufacturing Company and the Lawrence Manufacturing Company—both in Lowell, Massachusetts—all dropped substantially within the first two years of the war before reaching their respective lowest values in 1863. In fact, Lawrence completely shut down in March of that year and Hamilton followed suit in September. Outside of Lowell, the Boston Manufacturing Company in Waltham, Massachusetts also did not operate for five months in 1863 (Boston Manufacturing Company, 1864a).[11]

[Figure 3 about here]

Attitudes began shifting in 1864 as some raw cotton started to make its way North. After persuading Lincoln to loosen restrictions on trade between the North and South (Surdam, 1999), cotton mill executive Edward Atkinson (1864, p. 112) boisterously claimed in his report to the

[10] For instance, in 1862, the North imported 25,000 to 30,000 bales of Surat (India) cotton, which was around 3% of the quantity of American cotton that made its way to Northern states in 1860 (Atkinson, 1863, p. 99, 101).

[11] The only people employed during those months worked in the machine repair shop, as yard hands, or as watchmen. During the entirety of 1863, those three categories received 83% of the workers' total compensation, compared to 20% in January 1862.

Boston Board of Trade that "The Cotton Famine has passed, without ever having been reached...a supply of cotton is being received sufficient for the manufacture of all goods which can be sold." This belief proved to be misguided, however, as Southern cotton exports in 1864 were only one-eighth of their prewar level (Surdam, 1999), and even when raw cotton started to arrive at the mills, it was very expensive. The treasurer of the Boston Manufacturing Company announced his intention in May to "continue running the mills notwithstanding the great advance on the price of cotton" (Boston Manufacturing Company, 1864b), but prices did not reach their apex until August 1864, and Atkinson (1865, p. 117) doubted whether more than a handful of firms were able to turn a profit that year. Similarly, Lawrence and Hamilton opened again in March and April, respectively, though they operated at nowhere near their prewar capacity through the end of 1865 (see figure 3). The state manufacturing censuses further indicate that in the final year of the war, cotton cloth production had dropped by almost 50% relative to 1855, while employment in the textile industry declined 32% (Commonwealth of Massachusetts 1856, p. 570-571; Commonwealth of Massachusetts 1866, p. 658-659).

Following the Confederacy's surrender, Southern cotton production rebounded quickly. After unsuccessful initial efforts to maintain the centralized gang system with free labor, family-based tenant farming soon emerged as the prevalent mode of production, under which landowners divided their plantations into plots of around 30 to 50 acres and rented them to families of freedpeople for cash, a fixed crop payment, or most often, a share of the total crop (Reid 1973; Jaynes 1986, p. 44, 188; Ransom and Sutch 2001, p. 87). While there was a decline in productivity under this new labor regime (Fogel and Engerman, 1974; Jaynes, 1986; Moen, 1992; Margo, 2004), figure 2 shows that cotton production returned to its pre-war level in the 1870s and continued to grow through the beginning of the 20th century.

The cotton textiles industry in Massachusetts appeared to rebound quickly in tandem. As figure 3 illustrates, output reached 1850s levels at both the Hamilton and Lawrence companies by the early 1870s. Statewide, the gross value of output in cotton goods was 31% above its 1855 level by 1875, while capital invested rose by 57%, employment was 73% higher, and male employment doubled (Massachusetts Bureau of Statistics of Labor, 1877).

3 Massachusetts Censuses of Manufacturing

I use manufacturing data from 19th century state and federal censuses to investigate the effect of the Civil War cotton shock on Massachusetts's economy.

Massachusetts was the first state to undertake its own manufacturing census in 1837, and it repeated this endeavor every decade from 1845 to 1895 (Commonwealth of Massachusetts, 1838, 1846, 1856, 1866; Massachusetts Bureau of Statistics of Labor, 1877, 1888, 1898). I have digitized all seven of these censuses, which I augment with Massachusetts's returns from three federal manufacturing censuses (1850, 1860, 1880) to construct town-year and town-industry-year panels of manufacturing outcomes.[12] For 1850 and 1860, I aggregate the Hornbeck et al. (2025) complete establishment-level returns by town, whereas for 1880, I have digitized outcomes from the tables in the state's abstract to the federal census (Massachusetts Bureau of Statistics of Labor, 1883).[13] Across the data sources, I consistently observe the value of manufacturing output, total manufacturing employment, and manufacturing employment by sex.[14]

Given the difficulties of collecting extensive manufacturing information in the first half of the 19th century, the data are imperfect for several reasons. Most notable is that all antebellum measures are undercounts. The earliest four state censuses reported statistics for a specific list of goods (see figure A1), and as a result, some important industries were either missing or insufficiently covered by the goods enumerated. While industry coverage improved over time, and some census enumerators often "[took] pains, in addition to their answers, to gather and present the statistics of other branches of industry" (Commonwealth of Massachusetts, 1838), one notable deficiency is the lack of data on the clothing industry outside of caps and hats. Specifically, caps and hats were on the list of goods provided to enumerators, but not any other item of clothing, such as shirts, pants, suits, and so on. Concerning the federal censuses, enumerators were instructed to record only establishments with an annual value of production output exceeding $500 (U.S. Census Office, 1860). This minimum requirement not only led to undercounts of town totals, but also the complete omission of any town with only small establishments; over 10% of all Massachusetts towns are missing entirely from the

[12] Appendix A.1 describes the data digitization process, including the automated procedure employed for the first four censuses and the steps taken to ensure a high degree of accuracy.

[13] While Hornbeck et al. (2025) have digitized all four 1850-1880 manufacturing censuses, I use only 1850 and 1860 because most counties in 1870 are missing from the Massachusetts state archives. As I have separately digitized the 1880 data from the Bureau of Statistics of Labor abstract, there was no need to duplicate that effort. Furthermore, I do not include these three censuses in the town-industry panel due to the $500 minimum issue mentioned below. For more detail, see section 4.2.

[14] All employment counts include children, since it is not possible to disentangle adult from child employment in years when the data were not reported separately.

1860 federal census. For this reason, I do not include the 1850, 1860, and 1880 censuses in the town-industry panels. With that level of granularity, it is not possible to distinguish true zeroes and town-industry cells with small establishments.

Measurement error will be a concern if undercounting is endogenous to a town's exposure to the cotton economy. While there is no particular reason to believe this is the case, by having two different antebellum data sources with different forms of measurement error, a lack of pretrends would rule out any concerns since it is quite unlikely that prewar estimates from both sources would be systematically biased by similar amounts in the same direction. However, there is one particular case where a large measurement error appears to threaten identification (clothing in 1855 Boston), which I discuss further in section 5.1.

3.1 Defining Cotton Towns

I use the 1855 Massachusetts manufacturing census to classify cotton towns. Similar to Hanlon (2017), I define a cotton town as a municipality with greater than 20% of total employment in 1855 in the production of cotton textiles or printed cloths such as calicoes. This definition of treatment is ideal for two important reasons. First, although I have collected town-level employment figures from the 1860 federal census of manufactures, the 1855 state census has better coverage than the federal censuses which only include establishments producing more than $500 in output. Second, while there are still some issues with the 1855 data—namely, the incomplete coverage or, in some cases, complete omission of several key industries in the enumeration instructions—I mitigate many of these concerns by adopting a binary measure because it is more robust to measurement and data quality errors than continuous alternatives (e.g., the labor share in cotton textiles).

[Table 1 and figure 4 about here]

Table 1 contains summary statistics for cotton and non-cotton towns, and figure 4 shows their distribution throughout Massachusetts. Cotton towns were spread throughout the state, and there was substantial variation both within and across towns by treatment status. Broadly, cotton towns tended to have greater immigrant and female populations as well as more manufacturing activity. Differences in means for manufacturing outcomes, however, are not statistically significant once they are weighted by antebellum employment, which I do when estimating my main specification (see section 4.1). Importantly, the manufacturing workforce was majority female in cotton towns and overwhelmingly the opposite in non-cotton towns (regardless of weighting), and this difference

is statistically significant.

3.2 Border Standardization

Finally, I gather a series of historical maps of Massachusetts to standardize data across census years. Between 1837 and 1895, over 50 new municipalities were incorporated in Massachusetts, while five were absorbed into existing ones, and borders between adjacent towns changed quite frequently (Massachusetts Bureau of Statistics of Labor, 1908). Since Massachusetts municipality boundaries from the 19th century have not been previously digitized, I collect historical maps from the Digital Commonwealth archives database and digitize town boundaries in census years using ArcGIS. I then follow Hornbeck (2010)'s intersection procedure to standardize data to 1855 town borders (see Appendix A.2 for details).

4 Empirical Strategy

To estimate the causal effect of the cotton supply shock on Massachusetts's manufacturing economy, I begin by comparing manufacturing outcomes before, during, and after the Civil War between cotton and non-cotton towns using a differences-in-differences identification strategy. I then turn to investigating how the cotton textiles industry fared relative to other manufacturing industries across the state.

4.1 Cotton Town Event Study

I start with town-level manufacturing data from the Massachusetts and federal censuses covering the period 1837 to 1895. Since my goal is to identify the effect of the wartime shock on wartime and postbellum manufacturing outcomes in cotton towns, my target causal parameters are average treatment effects on the treated (ATTs) during and after the Civil War. Letting $Y_{\ell t}$ be an outcome in town ℓ in year t and $Y_{\ell t}(0)$ be that town-year's untreated potential outcome, that is, if the Civil War cotton shortage had never happened, my parameters of interest are:

$$\tau_t = \mathbb{E}[Y_{\ell t} - Y_{\ell t}(0) | CotTown_\ell = 1] \tag{1}$$

for $t \geq 1865$. Under the canonical parallel trends assumption these ATTs are equal to differences-in-differences, which can be estimated with a dynamic two-way fixed effects regression.[15]

I estimate the ATTs using Sant'Anna and Zhao (2020)'s doubly-robust differences-in-differences method, which is recommended when parallel trends only hold conditional on covariates (see Roth et al. 2023). Sant'Anna and Zhao (2020)'s estimator augments the standard differences-in-differences formulation by combining inverse probability weighting (IPW; accounting for each town's conditional probability of receiving treatment using propensity scores, $p(X_\ell) = \mathbb{P}(CotTown_\ell = 1|X_\ell))$ and regression adjustment (RA; accommodating how outcomes would evolve absent treatment across the distribution of covariates). The ATTs are thus identified as:

$$\tau_t = \mathbb{E}\Bigg[\underbrace{\left(\frac{CotTown_\ell}{\mathbb{E}(CotTown_\ell)} - \frac{\frac{(1-CotTown_\ell)p(X_\ell)}{1-p(X_\ell)}}{\mathbb{E}[\frac{(1-CotTown_\ell)p(X_\ell)}{1-p(X_\ell)}]}\right)}_{IPW}(Y_{\ell t} - Y_{\ell,1860} - \underbrace{\mathbb{E}[Y_{\ell t} - Y_{\ell,1860}|CotTown_\ell = 0, X_\ell]}_{RA})\Bigg] \tag{2}$$

and can be estimated by taking sample expectations and plugging in $\widehat{p(X_\ell)}$ and $\widehat{\mathbb{E}}(Y_{\ell t} - Y_{\ell,1860}|CotTown_\ell = 0, X_\ell)$ appropriately.[16]

There are three key elements of this specification to highlight. The first is the inclusion of time-invariant antebellum controls, which are each town's percent foreign born in 1860 to account for the surge of Irish famine and German "forty-eighter" immigrants who tended to settle in cities and manufacturing and mill towns (Ferrie, 1997; Alsan et al., 2020), along with an indicator for whether the town was urban (population > 2500). The second is that even when not estimated with a fixed effects regression, the differences-in-differences framework accounts for both unobserved time-invariant town characteristics (town fixed effects) and time-varying shocks common to the entire state (time fixed effects). Importantly, the latter absorb the statewide negative demand shock for manufactured goods during the Civil War in both cotton and non-cotton towns due to the loss of the Southern market, which hit major industries like boot and shoemaking in addition to cotton textiles (Engerman, 1966).[17] Finally, I weight estimations by 1855 manufacturing employment to account for heterogeneity in manufacturing involvement across towns prior to the Civil War in order

[15] That is: $\tau_t = \mathbb{E}[Y_{\ell t} - Y_{\ell,1860}|CotTown_\ell = 1] - \mathbb{E}[Y_{\ell t} - Y_{\ell,1860}|CotTown_\ell = 0]$ and τ_t's can be recovered by OLS estimation of $Y_{\ell t} = \sum_{s \neq 1860} \tau_s \times \mathbf{1}\{s = t\} \times CotTown_\ell + \alpha_\ell + \alpha_t + u_{\ell t}$ where α_ℓ, α_t are town and time fixed effects, respectively.

[16] There are multiple parametric and semi-/non-parametric methods for these two estimators. In practice, the propensity score is usually estimated by logistic regression, and the regression adjustment portion is estimated by fitting the conditional expectation function on untreated units with OLS and then plugging in X_ℓ for treated units. See Sant'Anna and Zhao (2020) for a complete treatment and Roth et al. (2023) for an overview.

[17] Notably excluded from the negative demand shock were industries that received wartime supply contracts, especially woolen goods. Section 5.1 discusses robustness of the main results to this fact.

to focus on the effects to places where manufacturing centered, like Lowell and Lawrence.

4.2 Cotton Textiles Industry Effects

I also investigate effects specific to cotton textiles using town-industry manufacturing data over the period 1837 to 1875. My parameters of interest are again ATTs of the form:

$$\tau_t^{cot} = \mathbb{E}[Y_{\ell it} - Y_{\ell it}(0) | i = Cotton\ textiles] \tag{3}$$

where i indexes industry. I estimate τ_t^{cot}'s with the following dynamic fixed effects specification:

$$Y_{\ell it} = \sum_{s \neq 1855} \tau_s^{cot} \times \mathbf{1}\{s = t\} \times \mathbf{1}\{i = Cotton\ textiles\} + \alpha_{\ell i} + \alpha_t + u_{\ell it} \tag{4}$$

where $\alpha_{\ell i}$ and α_t are town-industry and year fixed effects, respectively.[18] In the baseline specification, I do not include any controls or weight observations; however, I also present results with weighting and controls interacted with a full set of year fixed effects for comparison with the specification in section 4.1.

Due to data quality concerns, I omit several censuses from these analyses. First, I do not include the 1850, 1860, and 1880 federal manufacturing censuses because of the instruction that an establishment must have had greater than $500 in output to be enumerated (see section 3). Second, I remove the 1885 and 1895 state censuses for a similar reason: the Bureau of Statistics of Labor began to censor data for any town-industry cell with fewer than three establishments. Hence, I also do not know whether missing data reflects zero, one, or two establishments. Even when excluding these five censuses, I still have data across five years from 1837 to 1875.[19]

5 Results

Using the specification from the previous section, I demonstrate that the Civil War was a temporary adverse shock to women in manufacturing that did not affect the long-run development of Northern cotton towns. I then address potential threats to identification and show robustness to strengthen

[18] While Sant'Anna and Zhao (2020)'s approach is also valid to estimate the ATTs—and with no covariates and a balanced panel would produce identical estimates—the two methods handle unbalanced panels differently and can diverge. I perform both estimation methods for robustness but present only the dynamic fixed effects estimates in the main text. See section 5.2 for more detail.

[19] In table A5, I estimate the specification with all available data years, but only including town-industries with at least three establishments for consistency.

the causal interpretation of the results. I end by highlighting that this pattern of effects on cotton towns is consistent with the trajectory of the cotton textiles industry in Massachusetts, which suffered during the Civil War but rebounded quickly.

5.1 Large, Temporary Effects on Women

The Civil War shock caused a massive, but short-lived, contraction in female employment within cotton towns. Table 2 and figure 5 show the results of the doubly-robust differences-in-differences estimation (equation 2).

[Table 2 about here]

Female employment dropped by 87 log points (58%) during the war (see column (4)), while there was no statistically significant effect on any other available manufacturing outcome. Figure 5 particularly highlights the stark divergence in wartime employment by gender, as well as the immediate postwar recovery.

[Figure 5 about here]

Within ten years of the Union's victory, women's employment had more than rebounded as the estimated event study coefficient in 1875 is positive and economically large (45 log points), though not statistically significant.[20] In fact, estimates for all four outcomes are positive in every postbellum year of available data and statistically significant for male employment. These positive and significant coefficients should not be interpreted as direct effects of the Civil War cotton shock, since they only appear once Southern cotton production had returned to prewar levels; however, they still highlight that the wartime cotton scarcity did not impede cotton towns' long-term ability to flourish.

Examining event study coefficients in antebellum years allows me to rule out that differential underlying trends between cotton and non-cotton towns drive the results. All prewar estimates are close to zero in magnitude and statistically insignificant, except for female employment in 1855. While this may suggest a parallel trends violation, I contend that my main conclusion is well-identified for two reasons. First, I show in figure 6 that the supply shock caused the female share of manufacturing employment to decline by just over 20 percentage points relative to non-cotton

[20] As section 2.3 discusses, changes in the organization of Southern cotton production post-emancipation did not immediately bring the same level of output as under slavery; however, family-based tenant farming had prevailed and cotton production returned to prewar levels by 1875, which is the first available year of manufacturing data for Massachusetts.

towns during the Civil War.[21] Since I find no effect on wartime total employment and a positive, though insignificant, effect on male employment (table 2), this negative estimate on the female employment share strengthens the conclusion that women suffered the brunt of the cotton shock. Second, the large and statistically significant coefficient on log female employment in 1855 is due to measurement error and not unparallel trends. Specifically, Boston's female employment was severely undercounted since that year's census enumeration instructions omitted most articles of clothing.[22] As Boston was the largest non-cotton town in the state and my specification weights by antebellum manufacturing employment, a substantial decline in Boston's female employment from 1860 to 1855, absent a parallel decline within cotton towns, can explain the large positive estimate in 1855. To confirm, I perform a data correction[23] and re-estimate the main results in table A1, which shows that the 1855 coefficient becomes much smaller in magnitude and statistically insignificant.

[Figure 6 about here]

Finally, I demonstrate robustness in three ways. First, the main result is not sensitive to the chosen cutoff of 20% employed in cotton goods in the treatment definition. Figure 7 shows the estimated effect on log female employment in 1865 using different percentage cutoffs, and the estimates are all negative and statistically significant when varying the cutoff from 10% to 60%. Second, to show that the positive demand shock to woolen goods during the war due to army supply contracts does not drive the results, table A2 and figure A4 contain estimates while excluding all "wool towns"—those with greater than 20% employment in woolen goods—from the sample.[24] There is little change to the magnitude of estimates, and the interpretation is the same. Third, I conduct a randomization test to strengthen the conclusion that the wartime effect on female employment was specific to places specializing in cotton textiles production. Since there were 50 "true" cotton towns in Massachusetts, I perform 1,000 iterations of randomly assigning 50 towns to treatment and calculating the associated t-statistics for the ATT on log female employment in 1865. This is equivalent to drawing a sample of size 1,000 from the distribution of the t-statistic under the

[21] Although one of the prewar estimates is statistically significant, it is much smaller in magnitude than the estimated wartime effect and thus does not threaten the parallel trends assumption. If anything, the direction of the pretrend would suggest the negative effect in 1865 is underestimated.

[22] Section 3 contains further detail on the imperfections of the early state censuses.

[23] See Appendix B.1 for details.

[24] If wartime manufacturing activity increased in control towns where woolen goods production centered, then this could produce a negative coefficient on female employment even if there was no effect on cotton towns. Note that a transition to woolen goods in cotton towns may have dampened the effect of the wartime shock, but it does not present any threat to the identification strategy. Furthermore, as Engerman (1966) established, the aggregate growth in Massachusetts's woolen textiles industry during the war did not come close to making up for the loss to cotton textiles.

null hypothesis that there was no effect of the Civil War on female employment in cotton towns (see figure 8). The t-statistic associated with the true set of cotton towns—given by the dashed vertical line—is larger in magnitude than 99% of those generated by random assignment, providing overwhelming support for rejecting the null hypothesis in favor of a negative wartime effect on female employment.

[Figures 7 and 8 about here]

5.2 Immediate Rebound of Cotton Textiles

I now turn to investigating the effect of the supply shock on the cotton textiles industry using town-by-industry data. By estimating the differences-in-difference specification discussed in section 4.2 (equation 4), I show that the wartime supply shock depressed activity in cotton textiles, which recovered within a decade (see table 3). In the main specification, employment decreased by 16% during the Civil War (column (3)), while the postwar estimate is statistically insignificant.[25] Output followed a similar trajectory—negative estimate in 1865 and positive in 1875—though the former is not statistically significant. The lack of pretrends for either outcome (joint p-values of 0.162 and 0.724, columns (1) and (3), respectively) and the small postwar estimate for employment strengthen the causal interpretation that the supply shock caused a brief decline in cotton textiles before a quick rebound.[26] When considered with the lack of persistent effects on cotton towns, these results suggest that women returned specifically to cotton textiles employment postwar and not to other industries.

[Table 3 about here]

[25] See Bellemare and Wichman (2020) for the calculation of semi-elasticities when applying the inverse hyperbolic transformation to outcomes. While there are known issues with using this transformation (Chen and Roth, 2024; Thakral and Tô, 2026), table A3 shows that the result on employment is robust to adopting various recommended functional forms for dealing with outcomes containing zeros.

[26] As mentioned in section 4.2, I also estimate the effects on the cotton textiles industry using the Sant'Anna and Zhao (2020) approach in table A4. The reason why the point estimates diverge in the main specification (columns (1) and (3)) is that the two methods handle unbalanced panels differently. The Sant'Anna and Zhao (2020) approach estimates τ^{cot}_{1837}, for example, by performing a simple two-period difference-in-difference in means between treatment and control groups from 1855 back to 1837 which restricts the data for both years to only town-industries that were included in those two censuses, whereas dynamic fixed effects uses every year of data to minimize the sum of squared residuals with demeaned observations. Since 1837 was the first state census and there were many industries mistakenly omitted from enumeration instructions (see section 3), Sant'Anna and Zhao (2020) estimates τ^{cot}_{1837} very differently because it is forced to remove all the observations for these missing industries in 1855 as well, leaving only five remaining—agricultural implements, boots and shoes, cotton goods, glass-making, and woolen goods. This small number of untreated groups can explain the large and significant negative estimated coefficients for both output and employment in 1837, and in other years when this industry omission is much less of an issue (for example, by 1845 there were 23 industries sufficiently included in the census), the estimates are overall numerically similar to those in table 3. In particular, while the column (3) estimate on employment in 1865 in table A4 is not statistically significant, it is statistically indistinguishable from the corresponding estimate in table 3.

6 Temporary Shocks and Temporary Effects: Mechanisms

What explains the quick recovery of the cotton textiles industry and its female workforce? In this section, I combine causal estimates with descriptive and historical evidence to show that the high turnover, migratory nature of the cotton textiles labor supply in Massachusetts was responsible for its resilience to the Civil War supply shock. This institutional feature explains why my findings differ from those in the literature on the cotton famine in Britain, as textile mills there hired their workers from the existing, permanent urban population.

6.1 Population Size: Comparison with the UK

Across the Atlantic, Britain also experienced a wartime cotton shortage during the "Lancashire cotton famine."[27] Similar to Massachusetts, during the first half of the 19th century, British cotton textile production centered in cities throughout Lancashire and Cheshire counties in Northwest England that relied on ever-increasing raw cotton imports from the Southern United States (Arthi et al., 2022). Where the antebellum British textiles industry differed from Massachusetts was that English mills relied on a "permanent factory population" with little migration to and from cotton towns (Dublin, 1993, p. 184).[28] The wartime shock was large and temporary as British raw cotton imports dropped steeply during the Civil War at the same time that the price of cotton exploded, before both returned to prewar levels almost immediately (Hanlon, 2015).

While there has been no study considering the effects of the cotton famine on manufacturing outcomes in Great Britain, the shock did produce some temporary and lasting consequences.[29] Specifically, there were temporary wartime increases in the density of sex work establishments and the number of workers seeking relief from local Poor Law Boards in cotton textile-producing areas of the country, but there were also sustained outmigration and long-run mortality increases among households working in cotton textiles (Hanlon, 2017; Arthi et al., 2022; Goehring, 2025).

Since this persistence in outmigration contrasts with the temporary nature of my findings, I

[27] See Arnold (1864); Watts (1866) for extensive contemporary accounts and *The Spectator* (1864) for a concise summary.

[28] To further illuminate this point, Lancashire "retained more of its native population than other county, received little long-distance immigration, and swamped its immigrants through a high indigenous birth-rate" (Farnie, 1979, p. 71-72).

[29] Hanlon (2015) does document growth in inventions to specifically accommodate lower-quality Indian cotton, but no research has examined overall manufacturing activity by town, industry, town-industry, and so on. Interestingly, Massachusetts did not see any technological innovation in cotton textiles as efforts to supply Indian cotton were not fruitful (see section 2.3), and innovative energies were dedicated almost exclusively to war technologies (cannons, projectiles, small arms, cartridges, etc.) (Thomson, 2010; Khan, 2015).

investigate the effects of the wartime supply shock on population size in Massachusetts cotton towns. To do so, I gather town-level population counts from each available state (Haines, 2022) and federal (Ruggles et al., 2024) census between 1850 and 1900.[30] I construct the town counts from federal censuses by geolocating individuals in the IPUMS complete-count data to their town of residence and aggregating. For all years except 1860, I use the Census Place Project (Berkes et al., 2023) to do so, while for 1860, I examine the raw place name variables in the restricted IPUMS files to assign individuals to towns.[31] To estimate the effect of the cotton shock on cotton towns, I adopt the same doubly-robust differences-in-differences specification described in section 4.1, with demographic replacing manufacturing outcomes.

[Table 4 about here]

I find no temporary or persistent negative effects on population in Massachusetts cotton towns. Results are shown in table 4. The effects of the cotton shock on total population and population by gender at the end of the war in 1865 are all positive in the main specification (columns (2), (4), and (6)), and statistically significant except for women. In stark contrast to Britain, all postwar estimates are large and positive regardless of the inclusion of controls and weights; overall, postbellum total population compared to 1860 grew by 64 log points (90%) in cotton towns relative to non-cotton towns (22 log points without controls and weighting). Effects on men were larger than on women; however, the estimated coefficient on female population share is small in magnitude (-1.89 percentage points) and statistically significant only once dropping controls and weights.

6.2 The Postwar Labor Supply

While the previous section's results on population size imply that there would be enough workers to fill up the cotton mills, it does not illuminate the particular mechanisms by which cotton textiles and its female workforce recovered so quickly. Specifically, did the same women return to the mills? If not, then where did the new labor supply come from? Ideally, to answer these questions, I would use a panel dataset of Massachusetts mill workers gathered at regular (e.g. annual) frequency across the prewar, war, and postwar periods so that their outcomes could be compared to workers in other industries and prior and future cohorts of mill workers. Unfortunately, such data do not exist, and

[30] State censuses were every decade for years ending in five starting in 1855, while the federal decennial censuses were in years ending with zero. The original returns from the 1890 census were lost in a fire.

[31] The places identified in the Census Place Project's algorithm for 1860 Massachusetts, which appear to be based on the closest post office, do not correspond directly to the state's towns.

while the linked complete count federal censuses come closest, they still present major limitations. First, people are only observed at ten year intervals, and as section 2.1 emphasizes, the modal female mill worker was an unmarried teenager who only worked there for a few years. As a result, most women employed in cotton textiles in 1860 would not have remained by 1870 even if the Civil War had never occurred. Second, occupational reporting among women is quite poor in the prewar censuses. In 1850, enumerators were not instructed to record women's occupations at all (see the top panel of table 5), and though they began in 1860, the data are lacking. Overall 77% of women in Massachusetts had a missing response to the occupation question, and in Lowell and Fall River, two of the most prominent cotton towns, "wife" is the recorded occupation of every 1 out of 4 and 2 out of 5 women aged fifteen and older, respectively. Hence, while the 1860 census does provide a sample of female cotton textile workers just before the onset of the Civil War, it is certainly a selected sample.

[Table 5 and figure 9 about here]

Nevertheless, these census data do provide descriptive evidence that a new generation of young women came to work in the mills after the war ended. Using the 1850-1880 complete count censuses (Ruggles et al., 2024), table 5 contains summary statistics of workers in Massachusetts by sex across textile industries for each decade, and figure 9 shows the age distribution of female cotton textile workers in 1870. Then—and similar to other decades—the median age of female cotton textile workers was 20, while 65% were under the age of 23 and would have been less than 15 years old when mills began to shut down in 1861.[32] Furthermore, of those female cotton textile workers that were linked to the 1860 census by the Census Tree Project (Buckles et al., 2025), over half had lived in a out-of-town ten years prior, which is substantially larger than the share for women working in non-textile industries and suggests that they had been recruited from elsewhere.

Contemporary sources also provide corroboration that a new cohort of female workers arrived to cotton towns after the war. According to Lawrence Manufacturing Company records, since many of its female operatives had left by the end of 1861, an agent of the company remarked after the war's end in 1865 that "'the girl market is as excited as the stock market ever was"' (Layer, 1955, p. 32-33). To house the newly arriving textile workers, the Boston Manufacturing Company's board of directors approved the allocation of $8,000 to build eight new boarding houses on May 9, 1866 (Boston Manufacturing Company, 1866). A recruitment poster of the same company from 1870

[32] Although some as young as 10 worked in the mills as "bobbin girls"—replacing full bobbins with empty ones—the women that worked the rest of the production process were almost always over 15 (Dublin, 1994, p. 64, 67, 69).

(figure A5) describes an agent of the company traveling through Burlington, Vermont, St. Albans, Vermont, and Rouses Point, New York to hire "75 young women from 15 to 35 years of age" to work in the company's mills in Lowell and Chicopee. Clearly, the systems of labor recruitment had picked up where they left off before the war and were able to return cotton towns and the cotton textiles industry to their prewar trajectories.

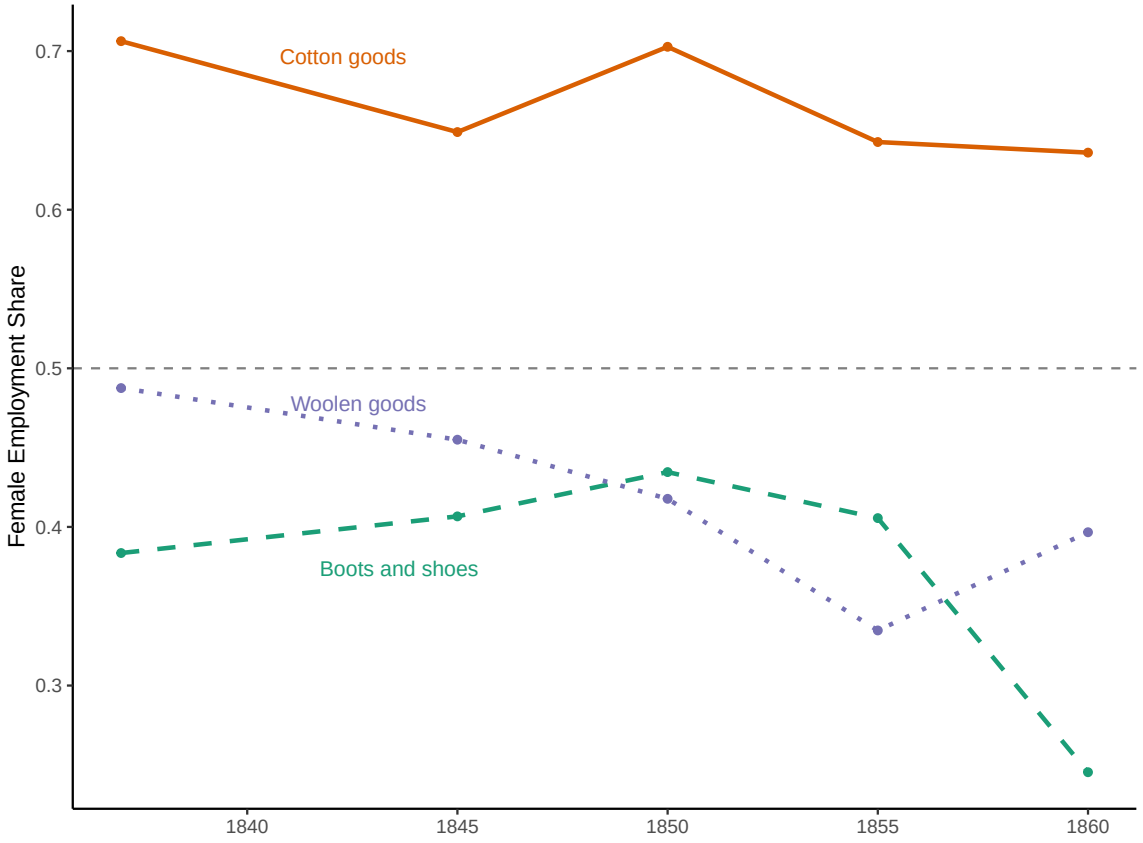
7 Conclusion

This paper studies the effects of the cotton supply shock during the American Civil War on manufacturing in Massachusetts. I find that towns in Massachusetts dependent on the cotton economy saw a large contraction in wartime female employment, while male employment and output were unaffected. Women's employment rebounded by 1875, and postwar effects for men were positive. The cotton textiles industry as a whole followed a very similar path to female employment. As so many young, single women lost employment, and therefore several years of income for dowries, examining the effects of the cotton shock on marriage markets is a promising area for further research. Doing so, however, would require a careful approach to disentangle the effects of this shock from other ones, particularly that many men of marriageable age died in the same period fighting for the Union.

These results provide causal identification to support the prevailing wisdom that the Civil War did not hinder long-run manufacturing growth in the North and also contrast with the experience in Britain (Hanlon, 2017; Arthi et al., 2022). The high turnover nature of the labor supply in Massachusetts's cotton textiles industry explains its resilience to the large supply shock as the continual recruitment of women to temporarily migrate to cotton towns and work in the mills had been established for decades prior to the war. Similar to Britain, many workers did leave town when the cotton ran out; mills were just well set up to recruit a new cohort after the war's end. Exploring more generally how the effects of large shocks on migration have differed across varied geographic, cultural, and institutional landscapes is a fruitful avenue for future research.

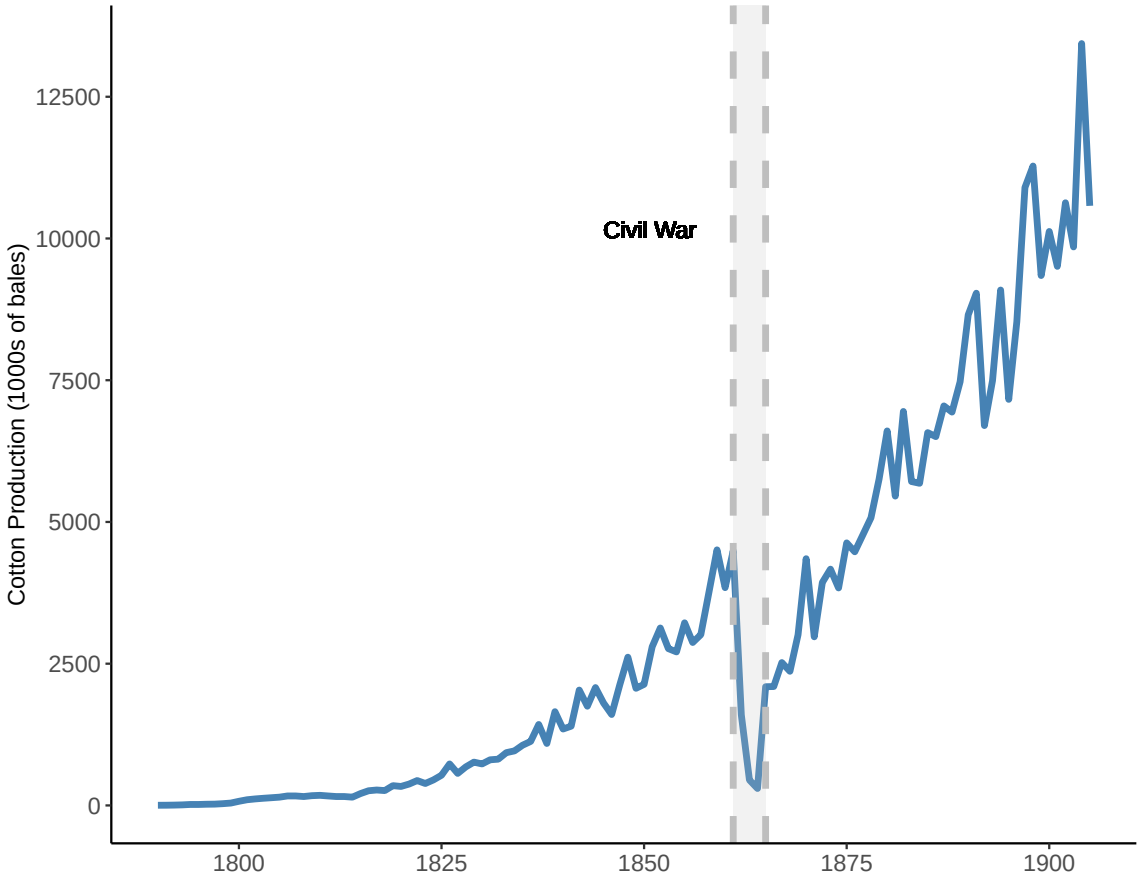
Figures and Tables

Figure 1: Women's Work in Antebellum Massachusetts



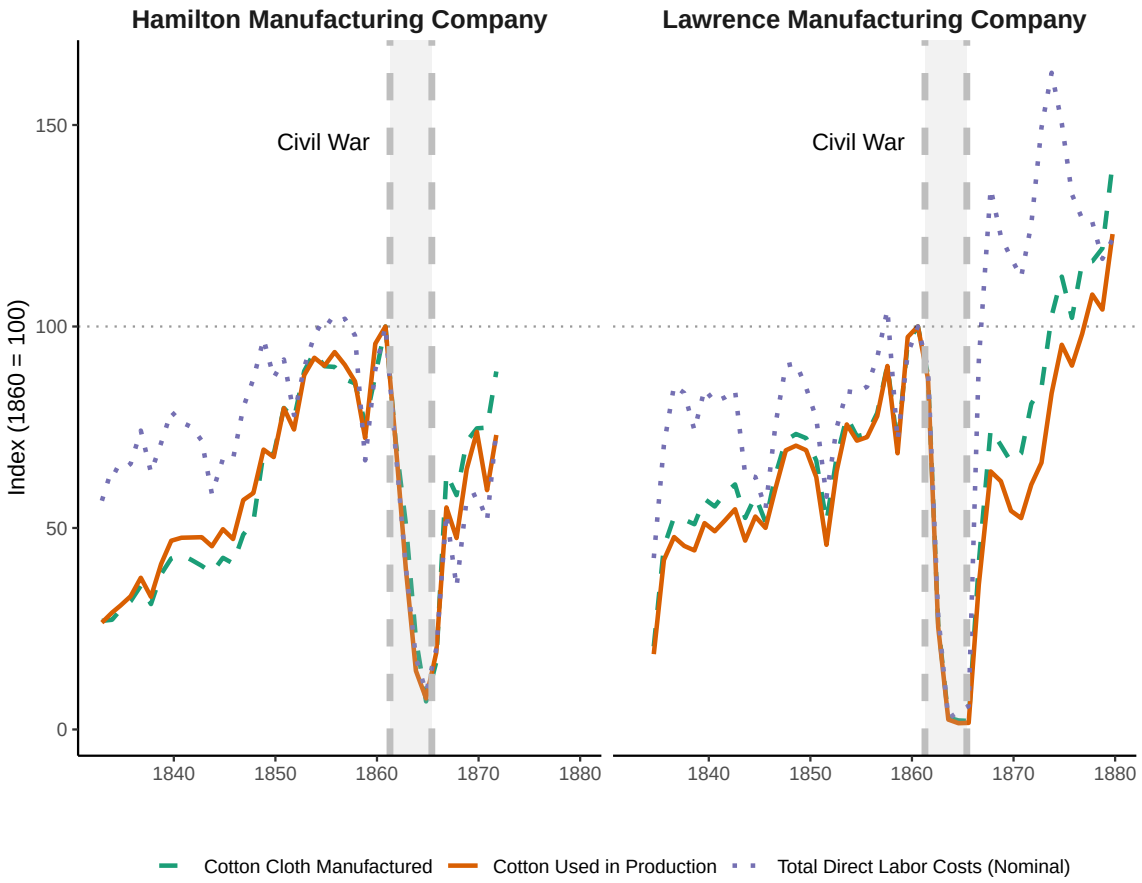
Notes: Female Employment Share$_i$ = $(\sum_\ell \text{Female Employment}_{i\ell})/(\sum_\ell \text{Employment}_{i\ell})$ where $i \in$ {Boots and shoes, cotton goods, woolen goods} and ℓ indexes towns. These three industries are included because they have consistent data coverage and together accounted for at least 2/3 of female manufacturing employment in Massachusetts. *Sources:* Commonwealth of Massachusetts (1838, 1846, 1856); Hornbeck et al. (2025). See section 3 for further information on data sources.

Figure 2: The Civil War Cotton Production Shock



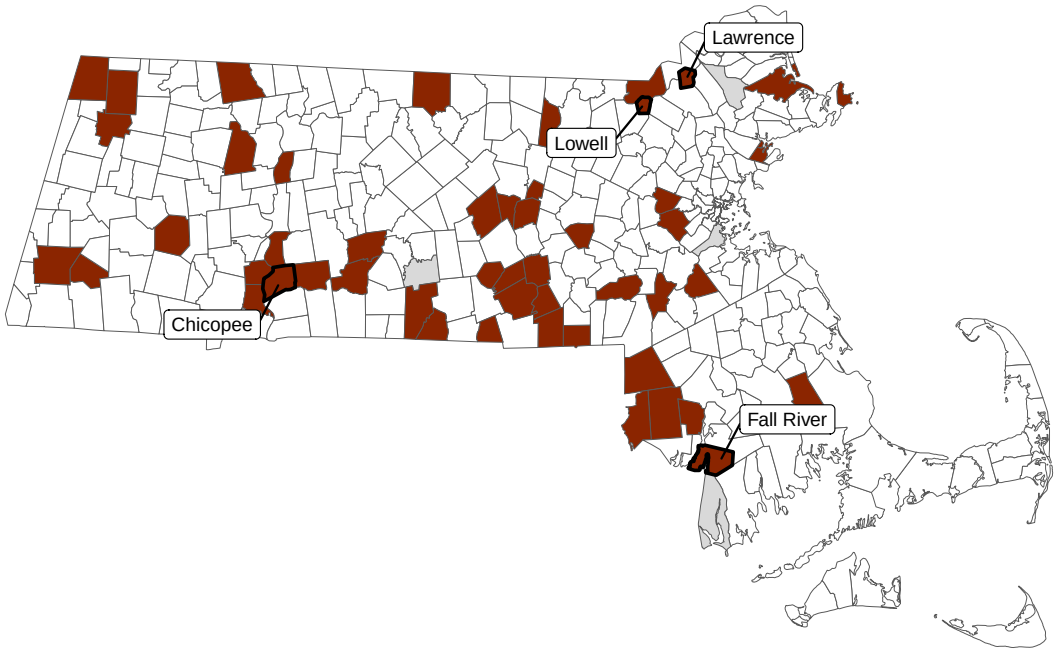
Source: Southern cotton output from Olmstead and Rhode (2006), Table Da755-765.

Figure 3: The Cotton Famine in Massachusetts



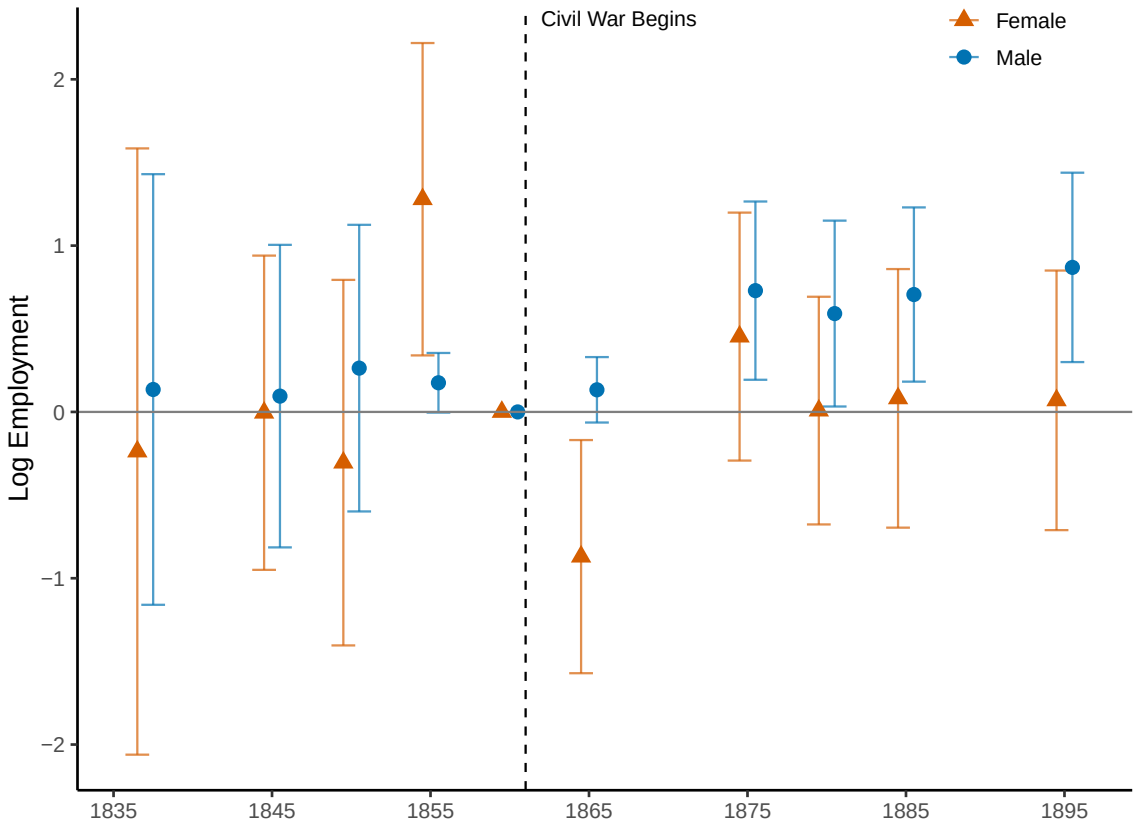
Notes: Annual yards of cotton cloth manufactured, pounds of cotton used in production, and total nominal direct labor costs relative to the 1860 baseline of two prominent textile companies in Massachusetts.
Source: Semiannual data collected by Layer (1951) from the original records of the Hamilton Manufacturing Company and Lawrence Manufacturing Company kept in the Baker Library Special Collections and Archives at Harvard Business School.

Figure 4: Massachusetts's Cotton Towns



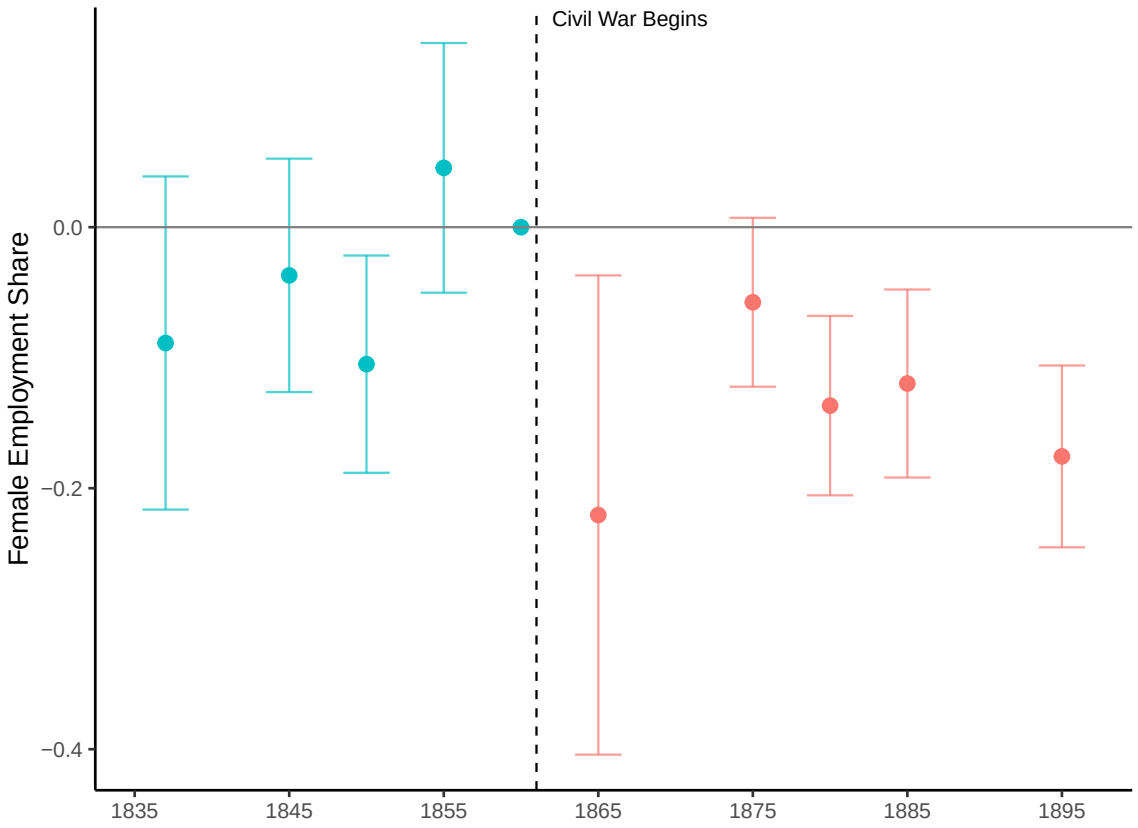
Notes: "Cotton towns"—those with > 20% of 1855 employment in cotton goods—are shaded red, with the four leading ones (by output, capital invested, and employment) labeled. See section 3 for further information.
Source: Employment data from the 1855 Massachusetts Census of Manufacturing (Commonwealth of Massachusetts, 1856), town borders from tracing maps (Walker, 1852; Walling, 1857) georeferenced to Massachusetts state boundaries (MassGIS, 2024) using ArcGIS (see section 3.2 and appendix A.2).

Figure 5: Gendered Effects of the Civil War Shock on Employment in Cotton Towns



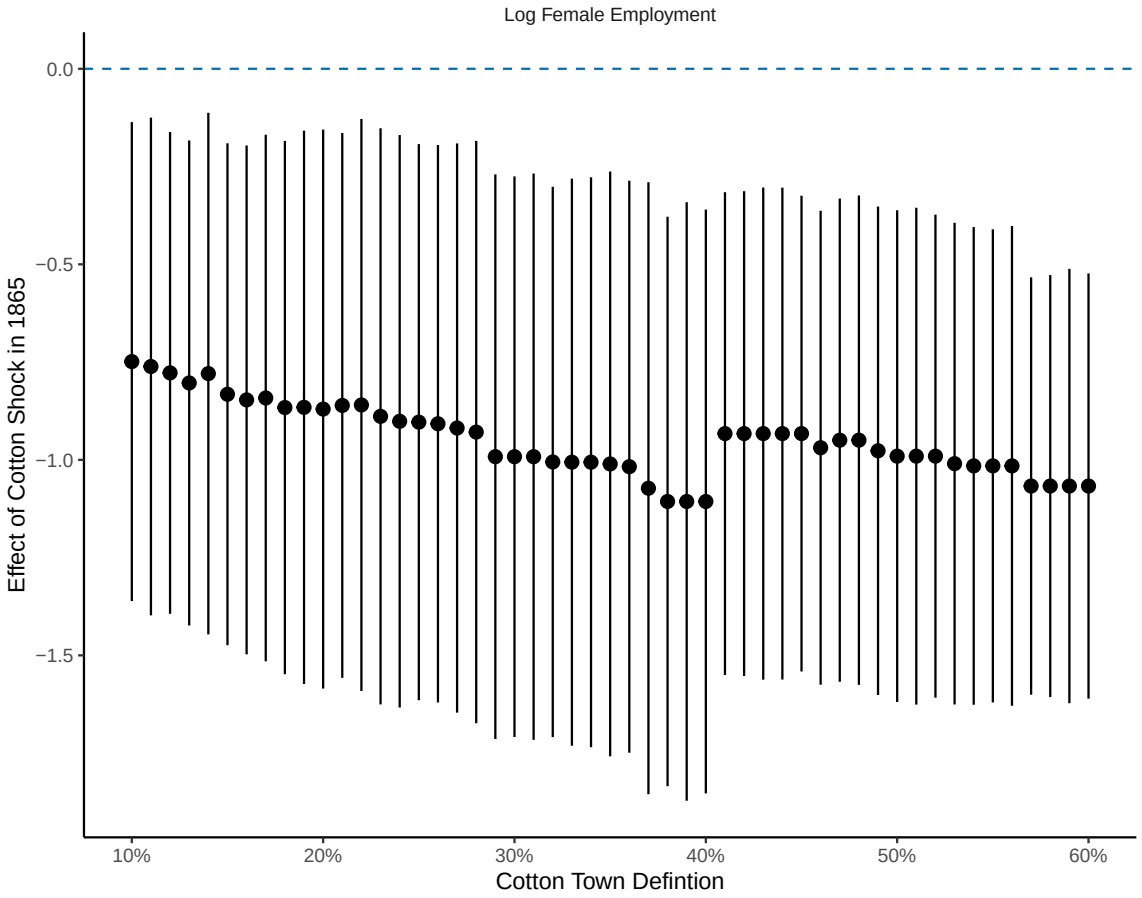
Notes: Event studies estimated using doubly-robust differences-in-differences (Sant'Anna and Zhao, 2020) with the R package `did` (Callaway and Sant'Anna, 2021). Treatment assigned at the town-level, where "cotton towns" are those with $>$ 20% of 1855 employment in cotton goods. All estimations control for the town's percent foreign born and an urban indicator (population $>$ 2500) in 1860, and observations are weighted by 1855 manufacturing employment. Bars reflect bootstrapped 95% simultaneous confidence bands with clustering by town.
Sources: Town employment data are from Commonwealth of Massachusetts (1838, 1846, 1856, 1866); Massachusetts Bureau of Statistics of Labor (1877, 1888, 1883, 1898); Hornbeck et al. (2025). Control variables come from the 1860 federal population census (Ruggles et al., 2024).

Figure 6: Negative Effect on Female Employment Share



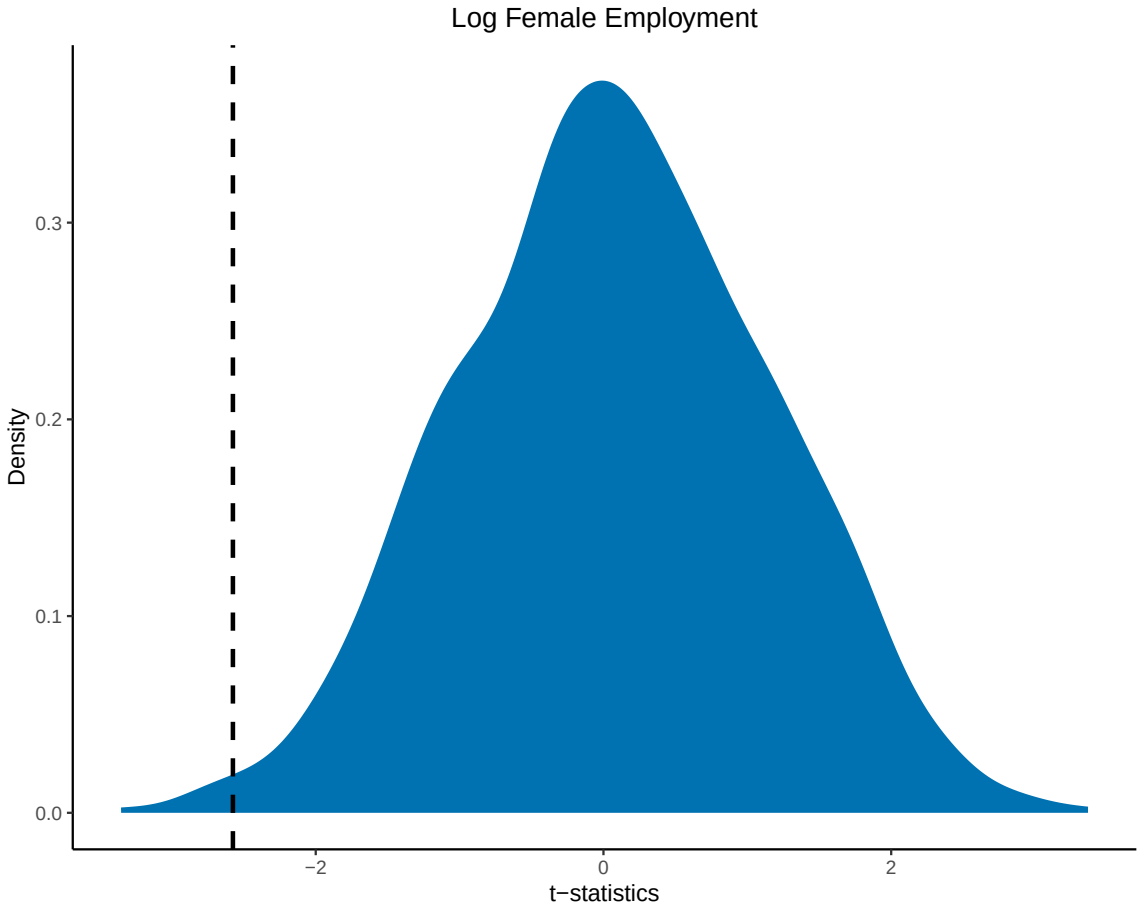
Notes: Event studies estimated using doubly-robust differences-in-differences (Sant'Anna and Zhao, 2020) with the R package `did` (Callaway and Sant'Anna, 2021). Treatment assigned at the town-level, where "cotton towns" are those with $>$ 20% of 1855 employment in cotton goods. The estimation controls for the town's percent foreign born and an urban indicator (population $>$ 2500) in 1860, and observations are weighted by 1855 manufacturing employment. Bars reflect bootstrapped 95% simultaneous confidence bands with clustering by town.
Sources: Town employment data are from Commonwealth of Massachusetts (1838, 1846, 1856, 1866); Massachusetts Bureau of Statistics of Labor (1877, 1888, 1883, 1898); Hornbeck et al. (2025). Control variables come from the 1860 federal population census (Ruggles et al., 2024).

Figure 7: Robustness to Different Cotton Town Definitions



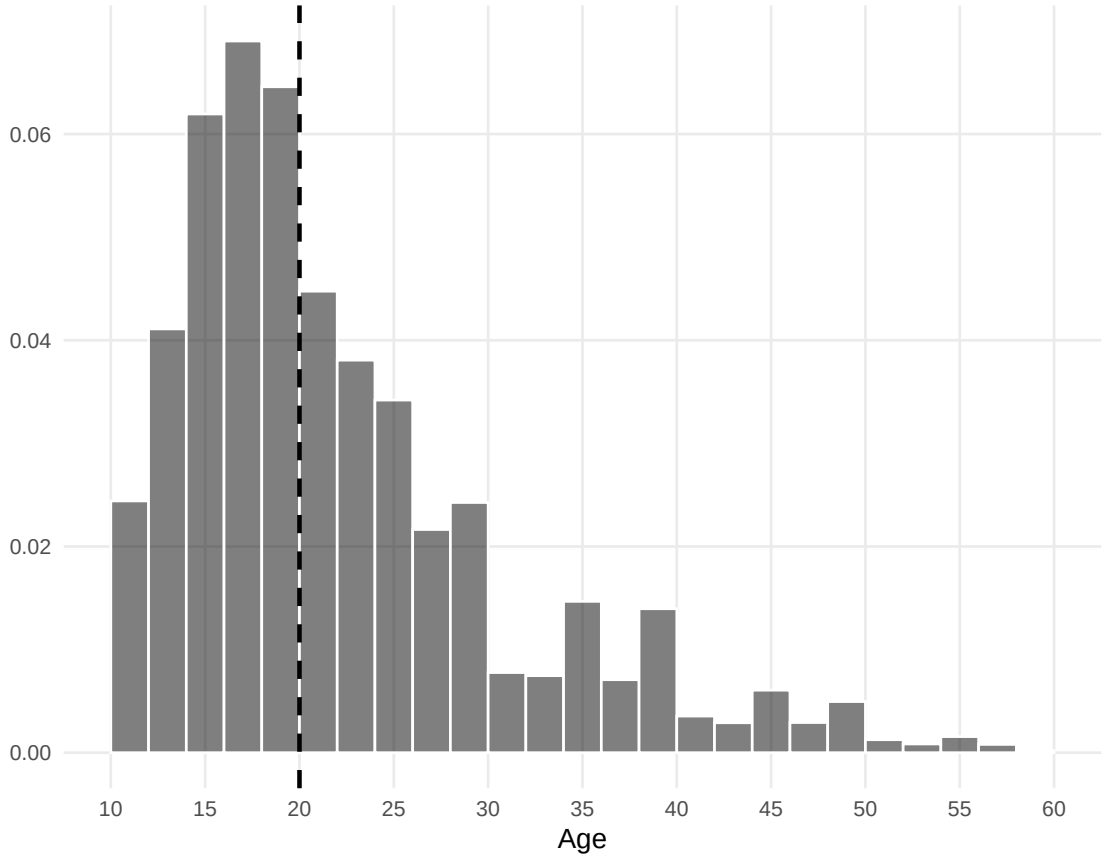
Notes: Estimated effect of the Civil War cotton shock on 1865 log female employment across different treatment definitions. Values on the horizontal axis correspond with cutoffs for percent of manufacturing employment in cotton goods to assign towns as cotton towns. Doubly-robust differences-in-differences (Sant'Anna and Zhao, 2020) performed with the with the R package `did` (Callaway and Sant'Anna, 2021). Each estimation controls for the town's percent foreign born and an urban indicator (population $>$ 2500) in 1860, and observations are weighted by 1855 manufacturing employment. Bars reflect bootstrapped 95% simultaneous confidence bands with clustering by town.
Sources: Town employment data are from Commonwealth of Massachusetts (1838, 1846, 1856, 1866); Massachusetts Bureau of Statistics of Labor (1877, 1888, 1883, 1898); Hornbeck et al. (2025). Control variables come from the 1860 federal population census (Ruggles et al., 2024).

Figure 8: Randomization Inference



Notes: Randomization test for the effect of the Civil War shock on log female employment in 1865. Distribution of 1,000 t-statistics generated by randomly assigning 50 cotton towns and estimating the main specification for each iteration. The vertical dashed line reflects the true t-statistic from the estimate in table 2, which is greater in magnitude than 98.8% of the t-statistics generated.
Sources: Town employment data are from Commonwealth of Massachusetts (1838, 1846, 1856, 1866); Massachusetts Bureau of Statistics of Labor (1877, 1888, 1883, 1898); Hornbeck et al. (2025). Control variables come from the 1860 federal population census (Ruggles et al., 2024).

Figure 9: Age Distribution of Female Cotton Textile Workers, 1870



Notes: Cotton textile workers in Massachusetts identified in the census using the 1880 OCC code 170 ("cotton mill operatives"). The vertical dashed line is at the median.
Sources: 1870 Population Census (Ruggles et al., 2024).

Table 1: Cotton Town Characteristics

	Town Means			Weighted Town Means		
	Cotton Towns	Non-Cotton Towns	Difference	Cotton Towns	Non-Cotton Towns	Difference
Demographics						
Population (1000s)	4.89	3.92	0.97	15.43	22.50	-7.07
	(6.32)	(11.95)	(1.18)	(13.46)	(46.75)	(13.92)
Share Foreign Born	0.21	0.12	0.09***	0.30	0.18	0.13***
	(0.11)	(0.08)	(0.02)	(0.09)	(0.09)	(0.02)
Female Share of Population	0.52	0.50	0.02***	0.55	0.51	0.04***
	(0.02)	(0.02)	(0.00)	(0.04)	(0.02)	(0.01)
Urban (pop $>$ 2500)	0.63	0.38	0.25***	0.93	0.82	0.11**
	(0.49)	(0.49)	(0.08)	(0.26)	(0.39)	(0.05)
Manufacturing						
Value of Manufacturing Output ($M)	1.56	0.76	0.80	7.79	5.31	2.47
	(3.42)	(2.60)	(0.51)	(8.82)	(9.62)	(4.54)
Total Manufacturing Employment (100s)	11.36	6.15	5.21*	49.96	41.54	8.43
	(20.95)	(16.37)	(3.13)	(50.58)	(52.47)	(24.62)
Female Share of Manufacturing Employment	0.41	0.22	0.19***	0.51	0.26	0.24***
	(0.15)	(0.19)	(0.02)	(0.14)	(0.18)	(0.05)
Share of Employment in Cotton Goods	0.44	0.02	0.43***	0.51	0.02	0.49***
	(0.19)	(0.04)	(0.03)	(0.18)	(0.04)	(0.04)
Observations	50	239	289	50	239	289

Notes: Columns 1 and 2 report unweighted town means of characteristics in cotton and non-cotton towns; columns 4 and 5 report town means weighted by 1855 manufacturing employment. Standard deviations are in parentheses below. Columns 3 and 6 contain differences in town means with and without weighting, respectively, with standard errors in parentheses below. Demographic variables come from the 1860 federal census of population (Ruggles et al., 2024). Manufacturing variables (output, male, female, and total employment) come from the 1860 federal census of manufactures (Hornbeck et al., 2025), and the 1855 state census of manufacturing (share of employment in cotton goods).
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 2: Event Study Estimates on Manufacturing Outcomes

	Log(Output ($)) (1)	Log(Employment) (2)	Log(Male Employment) (3)	Log(Female Employment) (4)
Cotton Town x 1837	0.03	0.03	0.13	-0.24
	(0.61)	(0.67)	(0.59)	(0.87)
Cotton Town x 1845	-0.01	0.01	0.10	-0.00
	(0.45)	(0.41)	(0.40)	(0.44)
Cotton Town x 1850	0.14	0.11	0.26	-0.31
	(0.40)	(0.44)	(0.39)	(0.52)
Cotton Town x 1855	-0.14	0.15**	0.18*	1.28***
	(0.12)	(0.07)	(0.08)	(0.44)
Cotton Town x 1865	0.12	-0.29	0.13	-0.87***
	(0.22)	(0.18)	(0.09)	(0.34)
Cotton Town x 1875	0.40	0.60**	0.73***	0.45
	(0.27)	(0.27)	(0.25)	(0.34)
Cotton Town x 1880	0.28	0.45	0.59**	0.01
	(0.33)	(0.27)	(0.25)	(0.32)
Cotton Town x 1885	0.26	0.48	0.71***	0.08
	(0.30)	(0.26)	(0.23)	(0.37)
Cotton Town x 1895	0.39	0.66**	0.87***	0.07
	(0.35)	(0.29)	(0.25)	(0.38)
Overall ATT	0.29	0.38*	0.61***	-0.05
	(0.26)	(0.21)	(0.2)	(0.25)
Pretrend test (p-value)	0.051	0.253	0.169	0.001
Dep. Var. Mean	12.401	5.345	5.052	4.430
Observations	2,843	2,854	2,854	2,136
Towns	288	288	288	236
Controls	✓	✓	✓	✓

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Event study using doubly-robust differences-in-differences (Sant'Anna and Zhao, 2020) with R package `did` (Callaway and Sant'Anna, 2021). Treatment assigned at the town-level, where "cotton towns" are those with $>$ 20% of 1855 employment in cotton goods. All estimations control for the town's percent foreign born and an urban indicator (population $>$ 2500) in 1860, and observations are weighted by 1855 manufacturing employment. Significance stars determined using bootstrapped simultaneous confidence bands with clustering by town. Sample size varies between columns due to the log transformation as many towns, particularly prewar, had no female manufacturing employment.
Sources: Town outcomes are from Commonwealth of Massachusetts (1838, 1846, 1856, 1866); Massachusetts Bureau of Statistics of Labor (1877, 1888, 1883, 1898); Hornbeck et al. (2025). Control variables come from the 1860 population census (Ruggles et al., 2024).

Table 3: Effect of the Civil War Shock on the Cotton Textiles Industry in Massachusetts

	Value of Output (IHS)		Employment (IHS)	
	(1)	(2)	(3)	(4)
Cotton Industry x 1837	-0.23	-0.18	-0.08	-0.22
	(0.25)	(0.79)	(0.10)	(0.34)
Cotton Industry x 1845	0.17	0.90	0.02	-0.00
	(0.21)	(0.98)	(0.08)	(0.40)
Cotton Industry x 1865	-0.16	0.56	-0.17***	-0.09
	(0.18)	(0.60)	(0.06)	(0.21)
Cotton Industry x 1875	0.20	1.20	-0.06	0.30
	(0.22)	(0.81)	(0.09)	(0.29)
Year FE	✓	✓	✓	✓
Town x Industry FE	✓	✓	✓	✓
Controls x Year		✓		✓
Weights		✓		✓
Pretrend test (p-value)	0.068	0.362	0.339	0.646
Dep. Var. Mean	2.464	2.480	0.837	0.843
Observations	43,967	43,572	44,090	43,697
Towns	330	327	330	327

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Estimation of town-industry-year regressions of the given manufacturing outcome on a cotton textiles industry indicator interacted with a full set of year indicators, along with the noted fixed effects, controls, and weights (equation 4). Controls are the town's percent foreign born and an urban dummy (population > 2500); weights are 1855 town manufacturing employment. Standard errors are clustered by town.
Sources: Outcomes and weights from Commonwealth of Massachusetts (1838, 1846, 1856, 1866); Massachusetts Bureau of Statistics of Labor (1877). Control variables come from the 1860 federal population census (Ruggles et al., 2024).

Table 4: Event Study Estimates on Population Outcomes

	Log(Population)		Log(Male Population)		Log(Female Population)		% Female (0-100)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cotton Town x 1850	0.01	0.26	0.00	0.25	0.01	0.27	0.17	0.51
	(0.06)	(0.26)	(0.06)	(0.26)	(0.06)	(0.28)	(0.34)	(0.62)
Cotton Town x 1855	0.01	0.11	0.00	0.11	0.01	0.12	0.23	0.36
	(0.02)	(0.11)	(0.02)	(0.11)	(0.02)	(0.12)	(0.19)	(0.37)
Cotton Town x 1865	-0.02	0.15**	-0.01	0.18***	-0.02	0.12	-0.34	-1.60
	(0.03)	(0.07)	(0.03)	(0.06)	(0.03)	(0.08)	(0.26)	(1.40)
Cotton Town x 1870	0.10**	0.51**	0.11**	0.53**	0.09*	0.50**	-0.37	-0.55
	(0.04)	(0.24)	(0.04)	(0.24)	(0.04)	(0.24)	(0.25)	(0.89)
Cotton Town x 1875	0.15**	0.75***	0.17***	0.79***	0.14**	0.72***	-0.74**	-1.64
	(0.05)	(0.27)	(0.05)	(0.28)	(0.05)	(0.28)	(0.26)	(1.16)
Cotton Town x 1880	0.22***	0.63**	0.24***	0.68***	0.21**	0.59**	-0.90**	-2.10
	(0.08)	(0.29)	(0.07)	(0.28)	(0.08)	(0.29)	(0.31)	(1.41)
Cotton Town x 1885	0.23**	0.63**	0.25***	0.67**	0.21**	0.59**	-0.78*	-1.84
	(0.08)	(0.29)	(0.08)	(0.28)	(0.09)	(0.29)	(0.32)	(1.21)
Cotton Town x 1895	0.31***	0.65**	0.33***	0.71***	0.28**	0.60**	-1.21**	-2.76**
	(0.10)	(0.29)	(0.10)	(0.28)	(0.10)	(0.30)	(0.40)	(1.33)
Cotton Town x 1900	0.35***	0.66**	0.38***	0.72***	0.31***	0.62**	-1.80**	-2.48
	(0.11)	(0.29)	(0.11)	(0.28)	(0.11)	(0.29)	(0.66)	(1.54)
Overall ATT (1870-1900)	0.23***	0.64**	0.25***	0.68**	0.21***	0.6**	-0.97***	-1.89
	(0.07)	(0.27)	(0.07)	(0.27)	(0.07)	(0.28)	(0.28)	(1.26)
Pretrend test (p-value)	0.955	0.351	0.998	0.380	0.875	0.330	0.496	0.568
Dep. Var. Mean	7.704	7.704	7.001	7.001	7.018	7.018	50.438	50.438
Observations	3,234	3,216	3,234	3,216	3,234	3,216	3,234	3,216
Towns	326	323	326	323	326	323	326	323
Controls		✓		✓		✓		✓
Weights		✓		✓		✓		✓

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Event study using doubly-robust differences-in-differences (Sant'Anna and Zhao, 2020) with R package `did` (Callaway and Sant'Anna, 2021). Treatment assigned at the town-level, where "cotton towns" are those with $> 20\%$ of 1855 employment in cotton goods. Columns (2), (4), (6), and (8) control for the town's percent foreign born and an urban indicator (population > 2500) in 1860, and observations are weighted by 1855 manufacturing employment. Significance stars determined using bootstrapped simultaneous confidence bands with clustering by town.
Sources: Town population counts from Haines (2022); Ruggles et al. (2024). Treatment defined using Commonwealth of Massachusetts (1856).

Table 5: Worker Characteristics, Pre- and Post-War

	Women				Men			
	1850	1860	1870	1880	1850	1860	1870	1880
Percent Reporting an Occupation	0.0	15.7	22.7	26.2	89.9	75.0	87.7	90.3
Percent with Non-Occupational Response	0.0	6.5	75.3	64.4	3.7	1.0	7.7	5.4
Percent Blank	100.0	77.4	1.4	9.2	6.2	21.6	0.7	3.9
Cotton textiles								
Median Age	–	21	20	21	26	28	25	23
Percent Under 23	–	61.5	64.9	64.5	35.9	32.0	47.0	52.5
Percent Native Born	–	40.8	45.4	43.3	42.1	34.4	40.5	38.8
Percent British	–	5.8	7.0	8.6	22.7	17.3	16.1	15.3
Percent Irish	–	45.2	28.8	20.0	24.3	37.6	24.0	15.9
Percent lived in other Town 10 Years Ago	–	52.2	54.7	44.2	–	63.9	59.7	51.2
Woolen textiles								
Median Age	–	20	20	20	30	30	28	26
Percent Under 23	–	67.6	66.7	65.8	24.2	29.6	38.1	43.6
Percent Native Born	–	61.9	48.3	56.3	43.2	43.6	34.0	45.1
Percent British	–	5.2	6.5	5.8	28.2	16.2	13.7	11.1
Percent Irish	–	26.7	30.5	20.8	24.8	31.0	34.6	23.5
Percent lived in other Town 10 Years Ago	–	50.3	53.2	38.4	–	53.0	60.5	49.5
Other industries								
Median Age	–	24	24	25	31	35	34	35
Percent Under 23	–	47.5	49.0	44.0	25.3	19.4	23.1	21.6
Percent Native Born	–	57.7	59.7	65.0	79.8	74.0	68.6	69.5
Percent British	–	1.6	1.8	2.1	2.1	2.3	2.6	2.9
Percent Irish	–	35.3	28.8	20.4	14.2	18.5	19.3	16.3
Percent lived in other Town 10 Years Ago	–	38.9	42.2	35.8	–	38.9	40.1	35.8

Notes: The top panel reports the extent to which occupations were recorded by sex and census year for the the population aged 15+ in Massachusetts. The subsequent three panels report worker characteristics by sex, industry, and year, with industries assigned to individuals using IPUMS 1880 OCC codes. For 1870 and 1880, individuals with OCC = 170 ("cotton-mill operatives") are assigned to cotton textiles, individuals with OCC = 264 ("woolen mill operatives") are assigned to woolen textiles, and all other occupational responses (OCC $<$ 301) constitute "all other industries". As census enumerators in 1850 and 1860 frequently recorded occupations as "mill hand", "mill operative", "spinner", "weaver", etc. without specificying the type of material, cotton textiles workers in this year include anyone with OCC code 170 as well as anyone with code 204 ("mill and factory operatives (not specified)") living in a town that either produced no woolen goods or had at least four times the employment in cotton goods as wooolen goods according the 1855 manufacturing census (Commonwealth of Massachusetts, 1856). Woolen textiles workers determined analogously.

Sources: 1850, 1860, 1870, and 1880 Complete Population Censuses (Ruggles et al., 2024), with individuals geolocated (in all years except 1860) to towns using the Census Place Project (Berkes et al., 2023). Worker characteristics in 1850 and 1860 are only among the population aged 15+, for whom enumerators were instructed to record occupations. 1870 and 1880 contain inidivuals of any age reporting an occupation in the given industry. Shares living in a different town from ten years prior calculated using Census Tree links between subsequent censuses (Buckles et al., 2025).

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Walling, Henry F. 1858. "Map of Boston and its vicinity: from actual surveys."

Ware, Caroline F. 1931. *The Early New England Cotton Manufacture: A Study in Industrial Beginnings*. Boston, MA: Houghton Mifflin Company.

Watts, John. 1866. *The Cotton Famine*. London: Simpkin, Marshall, & Co.

Worthington, Erastus. 1827. *The History of Dedham: From the Beginning of its Settlement, in September, 1635 to May, 1827*. Boston: Dutton and Wentworth.

Appendices

(for Online Publication only)

A Data

A.1 Digitization of the Massachusetts Censuses

I begin my discussion of the digitization of the various Massachusetts censuses with some background information. Each census was authorized by an act of the Massachusetts legislature to collect statistics related to industry within the state. The first two, 1837 and 1845, were standalone while starting in 1855 a decennial census of population accompanied each industrial census. For the first four–1837, 1845, 1855, and 1865–the legislative act specified a list of goods and corresponding statistics relating to industry to be gathered. Town assessors were provided with blank schedules in which to fill the requested information under penalty of a fine. The number of goods detailed in the respective legislative acts expanded quite dramatically, going from less than 40 in 1837 to over 200 in 1865. The goods included livestock and agriculture, and in 1865 even extended to assessing the value of all land. Starting in 1875, the goods were no longer specified in the act authorizing the census, and instructions were provided to enumerators in manufacturing schedules which have not survived. Town-by-industry and town-level aggregations of the statistics were then published.

The Massachusetts State Digital Archives contain scans of all eight documents. Two different procedures were used to digitize the data within the scans since the Massachusetts Bureau of Labor Statistics changed the way it presented information in its publications. As mentioned above, prior to 1875, the bureau's census reports included for each town a *list of goods* produced and the accompanying statistics, as can be seen in the example in Figure A1. Starting in 1875, the publications contain tabular reports at the town level. For the latter, the data from these PDF scans was entered manually into spreadsheets. Accuracy was verified by confirming published county totals equaled the sum of respective manually entered town values when possible; otherwise, I used double entry. I describe the process for digitizing the former in the following paragraphs.

First, I performed Optimal Character Recognition (OCR) of the PDFs using AbbyyFinereader. For each census, I then fed the text from the OCR into Anthropic's Claude Large Language Model with an accompanying prompt requesting that a .csv file containing a row for each good-town pair with the relevant statistics extracted from the text be outputted. As an example, Figure A2

shows the prompt and response for digitizing the page from the 1855 census in the left panel of Figure A1. Once this process was completed for each census, I cleaned up the outputs to get rid of consistent errors that the LLM tended to make, such as putting the wrong number of commas in a row, assigning total employment to the female employment column, and assigning the quantity of output to the number of establishments column.

The final step was a verification procedure to ensure a high degree of confidence in data accuracy. Due to LLMs' propensity to "hallucinate"—in this case, incorrectly transcribe manufacturing statistics from the OCRs of the original census documents—I developed a process to check the accuracy of the digitized .csv files using API querying with Claude.[33] For a given census, I looped through each row of the .csv, extracted the associated portion of the OCR-ed text, and prompted Claude to determine whether the information from both sources was identical (see Figure A3). Once every row had been processed, I manually checked all reported discrepancies with the original census document. Though I instructed the LLM to be overly cautious, leading to a substantial fraction of false positives, the procedure still reduced the number of good-town pairs to be manually verified from over 41,000 to around 3,800. I then aggregated the data to the town and town-industry level. For the latter, I first assigned each good to an industry based on the 63 manufacturing industries defined in detail by the Commonwealth of Massachusetts in 1875 and 1880. These crosswalks are included in the supplementary materials.

A.2 Border Standardization

Border standardization required digitizing census year municipality boundaries using historical maps and GIS software. A history of all municipality incorporations and border changes was provided in the 1905 Massachusetts Census of Population (Massachusetts Bureau of Statistics of Labor, 1908), which served as a useful reference throughout this procedure. Digitization and generation of boundary shapefiles were performed using Esri's ArcMap 10.8.1 and ArcGIS Pro 3.3. I began with an 1857 map of Massachusetts (Walling, 1857) to create the base year (1855) boundary shapefile. I georeferenced Walling (1857) to the state boundaries provided by MassGIS (2024), then used the editor tool to trace over the municipality boundaries on the historical map. Since the boundaries between Stoneham and South Reading and Braintree and Quincy changed in 1856, these were traced

[33] As an example, Claude had transcribed that there 250,000 people worked in making cotton goods in the town of Lawrence in 1855, despite the fact that the town only had a population of 16,114.

using an 1852 map of the commonwealth[34] (Walker, 1852), while several towns in the Boston area were traced from Walling (1858) due to the poor quality of this region in the 1857 state-wide map.[35]

To create boundary shapefiles in other census years, I use the municipality history provided in the 1905 census to make note of which towns had borders different from their 1855 borders in a given census year. Then, starting with the 1855 boundary shapefile, I delete the relevant polygons, use a historical map with the correct boundaries for that census year, georeference it to the state borders of the 1855 shapefile, and trace the town boundaries. After producing each census year town boundary shapefile, I standardize to 1855 boundaries using Hornbeck (2010)'s procedure.

[34]While the Massachusetts Bureau of Statistics of Labor (1908) notes boundary changes between Cambridge and Somerville and Beverly and Danvers in 1856, these were not discernible on the maps.

[35]These towns are Boston, Brighton, Brookline, Cambridge, Charlestown, Chelsea, Dorchester, Malden, Medford, North Chelsea, Quincy, Roxbury, Somerville, Watertown, West Cambridge, West Roxbury, and Winthrop.

B Results Appendix

B.1 Data Correction

In this Appendix, I describe the data correction discussed in section 5.1. I perform this correction as the undercounting of female employment in 1855 Boston explains the anomalously large and statistically significant pre-Civil War coefficient on log female employment that may raise concern of a parallel trends violation. The abstract to the 1855 census of manufactures notes "the evident haste with which [it] was prepared" as "many important interests, such as printing and publishing, in all their various departments, engraving, building, coasting, the manufacture of clothing...were entirely overlooked" (Commonwealth of Massachusetts, 1856, p. xi-xii). From this list, clothing is the relevant glaring omission because it disproportionately employed women and centered in the state's biggest non-cotton town: Boston. Reported female employment in 1855 totaled only 275, which is a massive undercount when considering that over 4,000 Bostonian women worked in manufacturing just five years later in 1860. Hence, with estimations weighted by prewar manufacturing employment, such a substantial decline in Boston's reported female employment from 1860 to 1855 absent a parallel decline in cotton towns explains the large positive estimate in 1855.

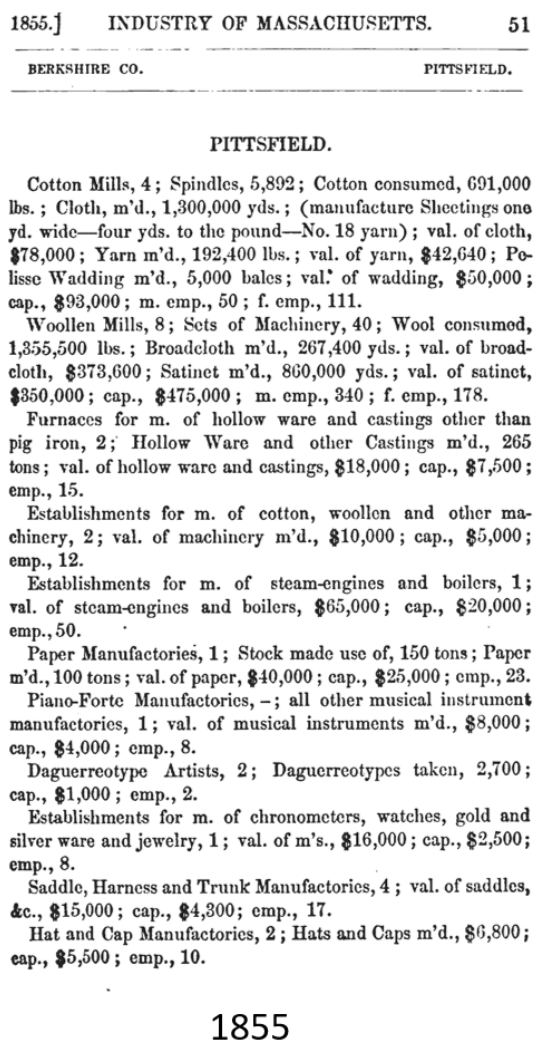
I perform the correction by adjusting employment counts for 1855 Boston using estimates of the clothing industry. Assessors for the city of Boston provided a figure for the value of clothing produced but, unfortunately, not employment. To generate estimates of the employment counts for men and women, I first calculate the average ratio of clothing's share of Boston's employment to its share of output from 1850 and 1860, which is roughly 1.8.[36] Then, taking clothing's share of output in 1855 (around 23%) and this ratio, I obtain an estimate of employment in clothing (approximately 8,400). I use the average gender composition of Boston's clothing employment in 1850 and 1860 ($\sim$ 70% female), to get final estimates of 1855 male and female employment.

Table A1 contains the results of the data corrected estimation. As column (4) shows, the 1855 estimate on log female employment is close to zero in magnitude and not statistically significant. Thus, with a far more accurate figure for female employment (and accordingly adjusted total and male employment) in 1855 Boston, there is no evidence of a pre-Civil War trend for any outcome.

[36] For instance, if clothing were 10% of the value of manufactured goods in Boston, then on average 18% of all manufacturing employment would be in the clothing industry.

C Additional Tables and Figures

C.1 Data and Digitization



1855.] INDUSTRY OF MASSACHUSETTS. 51

BERKSHIRE CO. PITTSFIELD.

PITTSFIELD.

Cotton Mills, 4; Spindles, 5,892; Cotton consumed, 691,000 lbs.; Cloth, m'd., 1,300,000 yds.; (manufacture Sheetings one yd. wide—four yds. to the pound—No. 18 yarn); val. of cloth, $78,000; Yarn m'd., 192,400 lbs.; val. of yarn, $42,640; Polisse Wadding m'd., 5,000 bales; val. of wadding, $50,000; cap., $93,000; m. emp., 50; f. emp., 111.

Woollen Mills, 8; Sets of Machinery, 40; Wool consumed, 1,355,500 lbs.; Broadcloth m'd., 267,400 yds.; val. of broadcloth, $373,600; Satinet m'd., 860,000 yds.; val. of satinet, $350,000; cap., $475,000; m. emp., 340; f. emp., 178.

Furnaces for m. of hollow ware and castings other than pig iron, 2; Hollow Ware and other Castings m'd., 265 tons; val. of hollow ware and castings, $18,000; cap., $7,500; emp., 15.

Establishments for m. of cotton, woollen and other machinery, 2; val. of machinery m'd., $10,000; cap., $5,000; emp., 12.

Establishments for m. of steam-engines and boilers, 1; val. of steam-engines and boilers, $65,000; cap., $20,000; emp., 50.

Paper Manufactories, 1; Stock made use of, 150 tons; Paper m'd., 100 tons; val. of paper, $40,000; cap., $25,000; emp., 23.

Piano-Forte Manufactories, –; all other musical instrument manufactories, 1; val. of musical instruments m'd., $8,000; cap., $4,000; emp., 8.

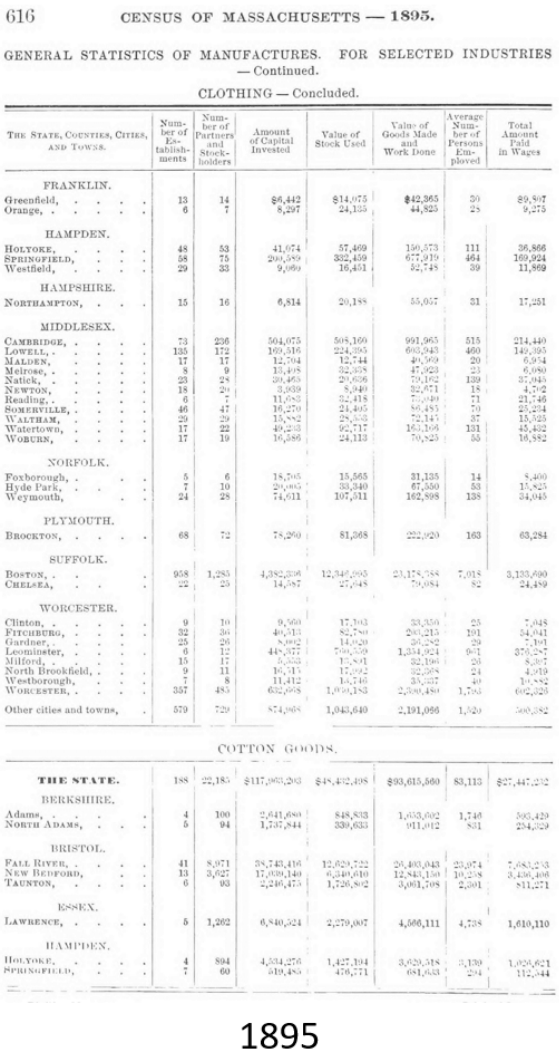
Daguerreotype Artists, 2; Daguerreotypes taken, 2,700; cap., $1,000; emp., 2.

Establishments for m. of chronometers, watches, gold and silver ware and jewelry, 1; val. of m's., $16,000; cap., $2,500; emp., 8.

Saddle, Harness and Trunk Manufactories, 4; val. of saddles, &c., $15,000; cap., $4,300; emp., 17.

Hat and Cap Manufactories, 2; Hats and Caps m'd., $6,800; cap., $5,500; emp., 10.

1855



616 CENSUS OF MASSACHUSETTS — 1895.

GENERAL STATISTICS OF MANUFACTURES. FOR SELECTED INDUSTRIES — Continued.

CLOTHING — Concluded.

The State, Counties, Cities, and Towns.	Number of Establishments	Number of Partners and Stockholders	Amount of Capital Invested	Value of Stock Used	Value of Goods Made and Work Done	Average Number of Persons Employed	Total Amount Paid in Wages
FRANKLIN.							
Greenfield,	13	14	$6,442	$14,075	$42,365	20	$9,907
Orange,	6	7	8,297	24,135	44,825	28	9,275
HAMPDEN.							
Holyoke,	48	53	41,074	57,469	190,573	111	36,866
Springfield,	58	75	200,589	332,459	677,979	464	169,924
Westfield,	29	33	9,999	16,451	35,745	39	11,869
HAMPSHIRE.							
Northampton,	15	16	6,814	20,188	55,057	31	17,251
MIDDLESEX.							
Cambridge,	73	236	504,075	508,160	991,965	515	214,440
Lowell,	135	172	169,516	224,395	605,943	460	149,395
Malden,	17	17	12,704	12,744	40,569	20	6,954
Melrose,	8	9	13,498	32,958	47,923	23	6,980
Natick,	23	28	20,463	20,606	70,192	139	37,045
Newton,	18	20	3,939	8,040	32,871	18	4,702
Reading,	6	7	11,682	32,418	70,049	71	21,746
Somerville,	46	47	16,270	24,405	86,453	70	23,274
Waltham,	29	29	15,882	28,503	72,145	87	15,525
Watertown,	17	22	49,203	92,717	163,106	131	45,402
Woburn,	17	19	16,586	24,113	70,923	55	16,582
NORFOLK.							
Foxborough,	5	6	18,705	15,565	31,135	14	8,400
Hyde Park,	7	10	20,000	33,340	67,350	53	15,825
Weymouth,	24	28	74,611	107,911	162,598	138	34,045
PLYMOUTH.							
Brockton,	68	72	78,290	81,368	222,020	163	63,284
SUFFOLK.							
Boston,	958	1,285	4,382,896	12,340,005	23,178,788	7,018	3,133,690
Chelsea,	22	23	14,587	27,048	79,084	82	24,489
WORCESTER.							
Clinton,	9	10	9,500	17,303	33,350	25	7,048
Fitchburg,	32	36	40,313	82,780	200,213	191	54,041
Gardner,	25	26	8,992	14,020	36,292	29	7,391
Leominster,	6	12	448,377	700,359	1,334,924	961	370,247
Milford,	15	17	5,953	12,801	32,196	20	5,267
North Brookfield,	9	11	16,315	17,092	32,568	24	4,919
Westborough,	7	8	11,412	15,746	35,237	40	10,882
Worcester,	337	483	652,998	1,009,183	2,300,480	1,753	602,228
Other cities and towns,	579	729	874,068	1,043,640	2,191,066	1,520	500,382
COTTON GOODS.							
THE STATE.	188	22,185	$117,983,203	$48,432,408	$93,615,560	83,113	$27,447,202
BERKSHIRE.							
Adams,	4	100	2,641,680	848,833	1,653,002	1,746	503,429
North Adams,	5	94	1,737,844	339,633	911,012	831	254,329
BRISTOL.							
Fall River,	41	8,971	38,743,416	12,029,722	26,403,043	23,974	7,683,273
New Bedford,	13	3,027	17,039,149	6,340,610	12,843,130	10,238	3,430,406
Taunton,	6	93	2,240,473	1,726,892	3,003,708	2,991	811,271
ESSEX.							
Lawrence,	5	1,262	6,840,924	2,279,007	4,566,111	4,738	1,610,110
HAMPDEN.							
Holyoke,	4	894	4,934,276	1,427,194	3,029,318	3,139	1,026,621
Springfield,	7	60	519,483	476,771	681,633	294	112,444

1895

Figure A1: Example Pages from 1855 and 1895 Massachusetts Industrial Censuses

A <<output_csv_file>>
<documents>
[Paste document]
</documents>
In the text file, there is information on production in Massachusetts in 1855. In each line there is a town, a good, and information on that good. Note that there are some mistakes so that some lines contain more than one good. Please create a CSV file containing data for every town mentioned in the text file with the following columns: Town, Good, Number of Establishments, Value of Output, capital invested (if provided), quantity of output, quantity of raw materials used in production (especially for cotton and woollen goods), male employment (if provided), female employment (if provided), and employment. Do not omit livestock and agricultural goods. Proceed in order of the towns as presented in the text document (e.g. Adams, then Alford, then Becket etc.). Include all towns. If the output is too long for a single message, please continue in subsequent messages without prompting, indicating clearly where you left off and where you're resuming. After you've finished listing all towns, please state 'End of town list.'
Some other instructions:
1. if m. or f. emp. is not specified for a good, then put the number emp. in the total employment column. Leave male employment and female employment blank for that row.
2. there should be exactly exactly 9 commas in every row of the csv. Make sure to check that each row has 9 commas before printing
3. Make sure that value of output and capital invested are in the correct columns. Do not put value of output in the capital invested column if cap. is not provided in the document.
<<output_csv_file>>

A Continue

Certainly, I'll continue with the next town, Pittsfield:

Town,Good,Number of Establishments,Value of Output,Capital Invested,Quantity of Output,Quantity of Raw Materials,Male Employment,Female Employment,Total Employment
Pittsfield,Cotton Mills,4,170640,93000,1300000 yds cloth; 192400 lbs yarn; 5000 bales wadding,691000 lbs,50,111,
Pittsfield,Woollen Mills,8,723600,475000,267400 yds broadcloth; 860000 yds satinet,1355500 lbs,340,178,
Pittsfield,Hollow Ware Furnaces,2,18000,7500,265 tons,,,,15
Pittsfield,Machinery Manufactories,2,10000,5000,,,,,,12
Pittsfield,Steam Engine Manufactories,1,65000,20000,,,,,,50
Pittsfield,Paper Manufactories,1,40000,25000,100 tons,150 tons,,,23
Pittsfield,Musical Instrument Manufactories,1,8000,4000,,,,,,8
Pittsfield,Daguerreotype Artists,2,,1000,2700,,,,2
Pittsfield,Watch and Jewelry Manufactories,1,16000,2500,,,,,,8
Pittsfield,Saddle Manufactories,4,15000,4300,,,,,,17
Pittsfield,Hat and Cap Manufactories,2,6800,5500,,,,,,10

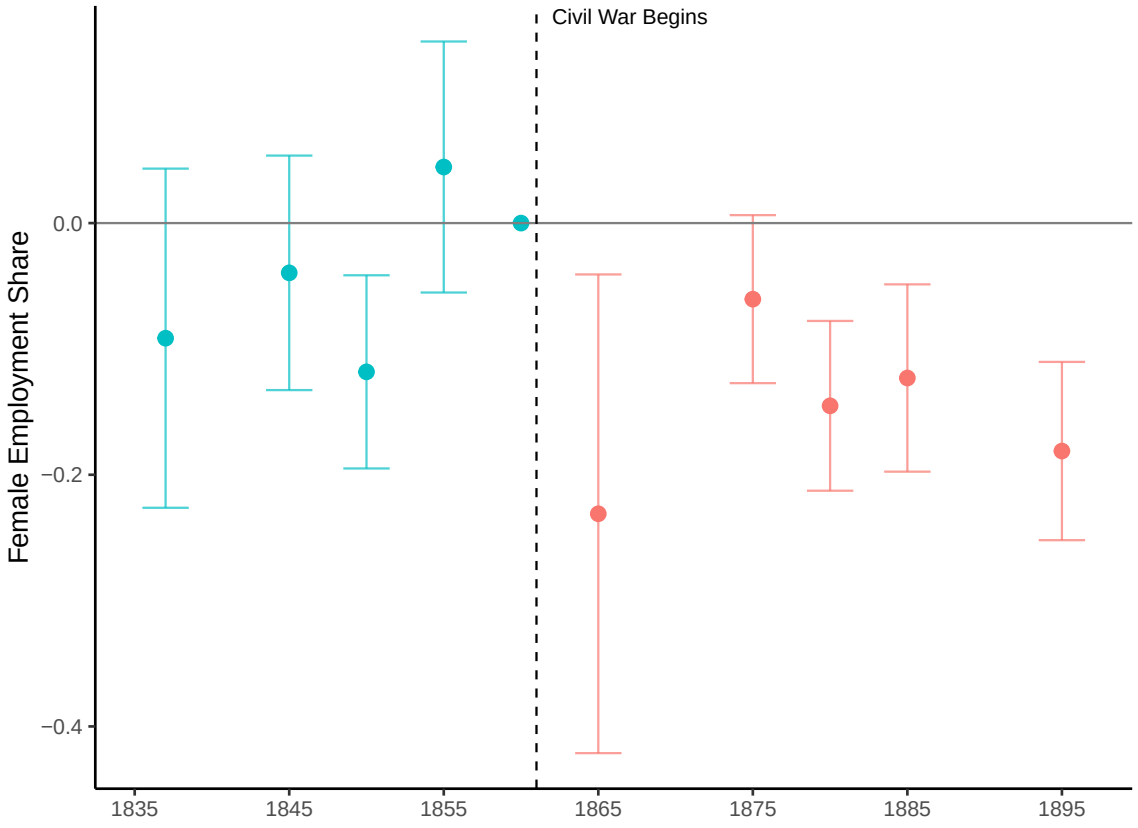
Figure A2: Example Claude Prompt and Response from Digitization Procedure

```
Carefully verify this CSV row against the OCR entries, paying special
    attention to numerical values:

CSV Row: \%s

OCR Entries: \%s

Verification Instructions:

1. Compare EACH numerical field EXACTLY

2. Check for:

   - Matching values (excluding currency symbols)

   - Correct decimal places

3. Identify ANY discrepancies, even minor ones

4. If values differ, explain the specific difference

5. Provide a corrected value

6. If NO discrepancies exist, respond with 'NO DISCREPANCIES'

Respond in strict JSON format
```

Figure A3: Verification Prompt

C.2 Results

Figure A4: Effect on Female Employment Share with Woolen Towns Removed



Notes: Event studies estimated using doubly-robust differences-in-differences (Sant'Anna and Zhao, 2020) with the R package `did` (Callaway and Sant'Anna, 2021). Treatment assigned at the town-level, where "cotton towns" are those with > 20% of 1855 employment in cotton goods. The estimation controls for the town's percent foreign born and an urban indicator (population > 2500) in 1860, and observations are weighted by 1855 manufacturing employment. Bars reflect bootstrapped 95% simultaneous confidence bands with clustering by town. "Wool towns", those with > 20% of 1855 employment in woolen goods, are removed from the sample as a robustness test due to the positive demand shock to woolen textiles during the Civil War as a result of substitution away from cotton textiles and contracting to make army supplies (Bond and Livermore, 1862, p. 128).
Sources: Massachusetts town employment data are from state (1837, 1845, 1855, 1865, 1875, 1885, 1895) and federal (1850, 1860, 1880) manufacturing censuses. Control variables come from the 1860 federal population census (Ruggles et al., 2024).

Table A1: Event Study Estimates on Manufacturing Outcomes with Data Correction

	Log(Output ($))	Log(Employment)	Log(Male Employment)	Log(Female Employment)
	(1)	(2)	(3)	(4)
Cotton Town x 1837	-0.09	-0.10	0.03	-0.43
	(0.56)	(0.60)	(0.51)	(0.78)
Cotton Town x 1845	-0.05	-0.01	0.06	0.01
	(0.45)	(0.39)	(0.41)	(0.44)
Cotton Town x 1850	0.05	-0.00	0.17	-0.43
	(0.34)	(0.37)	(0.33)	(0.44)
Cotton Town x 1855	-0.15	-0.06	0.09	-0.21
	(0.10)	(0.10)	(0.09)	(0.29)
Cotton Town x 1865	0.15	-0.30	0.16	-0.93***
	(0.23)	(0.17)	(0.09)	(0.33)
Cotton Town x 1875	0.49*	0.69***	0.81***	0.57
	(0.25)	(0.24)	(0.22)	(0.31)
Cotton Town x 1880	0.38	0.53**	0.67***	0.11
	(0.31)	(0.25)	(0.23)	(0.29)
Cotton Town x 1885	0.34	0.56**	0.78***	0.20
	(0.30)	(0.25)	(0.21)	(0.33)
Cotton Town x 1895	0.48	0.75***	0.95***	0.19
	(0.34)	(0.27)	(0.24)	(0.35)
Overall ATT	0.37	0.45**	0.67***	0.03
	(0.26)	(0.2)	(0.19)	(0.24)
Pretrend test (p-value)	0.064	0.674	0.606	0.633
Dep. Var. Mean	12.401	5.345	5.052	4.431
Observations	2,843	2,854	2,854	2,136
Towns	288	288	288	236
Controls	✓	✓	✓	✓

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Event study using doubly-robust differences-in-differences (Sant'Anna and Zhao, 2020) with R package `did` (Callaway and Sant'Anna, 2021). Treatment assigned at the town-level, where "cotton towns" are those with $>$ 20% of 1855 employment in cotton goods. All estimations control for the town's percent foreign born and an urban indicator (population $>$ 2500) in 1860, and observations are weighted by 1855 manufacturing employment. Significance stars determined using bootstrapped simultaneous confidence bands with clustering by town. Sample size varies between columns due to the log transformation as many towns, particularly prewar, had no female manufacturing employment.
Sources: Town outcomes are from Commonwealth of Massachusetts (1838, 1846, 1856, 1866); Massachusetts Bureau of Statistics of Labor (1877, 1888, 1883, 1898); Hornbeck et al. (2025). Control variables come from the 1860 federal population census (Ruggles et al., 2024).

Table A2: Event Study Estimates on Manufacturing Outcomes with Wool Towns Removed

	Log(Output ($))	Log(Employment)	Log(Male Employment)	Log(Female Employment)
	(1)	(2)	(3)	(4)
Cotton Town x 1837	0.06	0.03	0.14	-0.23
	(0.66)	(0.67)	(0.61)	(0.91)
Cotton Town x 1845	0.00	0.01	0.11	0.00
	(0.45)	(0.40)	(0.41)	(0.45)
Cotton Town x 1850	0.13	0.10	0.28	-0.36
	(0.40)	(0.43)	(0.40)	(0.51)
Cotton Town x 1855	-0.16	0.14	0.16*	1.32***
	(0.11)	(0.07)	(0.08)	(0.45)
Cotton Town x 1865	0.16	-0.26	0.17	-0.87***
	(0.23)	(0.18)	(0.09)	(0.34)
Cotton Town x 1875	0.44	0.66**	0.79***	0.49
	(0.27)	(0.27)	(0.25)	(0.37)
Cotton Town x 1880	0.33	0.51	0.66**	0.04
	(0.33)	(0.28)	(0.25)	(0.34)
Cotton Town x 1885	0.30	0.55*	0.79***	0.15
	(0.31)	(0.27)	(0.22)	(0.37)
Cotton Town x 1895	0.45	0.76***	0.96***	0.14
	(0.35)	(0.29)	(0.25)	(0.37)
Overall ATT	0.34	0.44**	0.67***	-0.01
	(0.26)	(0.21)	(0.19)	(0.26)
Pretrend test (p-value)	0.043	0.373	0.173	0.000
Dep. Var. Mean	12.321	5.291	5.007	4.403
Observations	2,527	2,534	2,534	1,824
Towns	256	256	256	204
Controls	✓	✓	✓	✓

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Event study using doubly-robust differences-in-differences (Sant'Anna and Zhao, 2020) with R package `did` (Callaway and Sant'Anna, 2021). Treatment assigned at the town-level, where "cotton towns" are those with > 20% of 1855 employment in cotton goods. All estimations control for the town's percent foreign born and an urban indicator (population > 2500) in 1860, and observations are weighted by 1855 manufacturing employment. Significance stars determined using bootstrapped simultaneous confidence bands with clustering by town. "Wool towns", those with > 20% of 1855 employment in woolen goods, are removed from the sample as a robustness test due to the positive demand shock to woolen textiles during the Civil War as a result of substitution away from cotton textiles and contracting to make army supplies (Bond and Livermore, 1862, p. 128). Sample size varies between columns due to the log transformation as many towns, particularly prewar, had no female manufacturing employment.

Sources: Town outcomes are from Commonwealth of Massachusetts (1838, 1846, 1856, 1866); Massachusetts Bureau of Statistics of Labor (1877, 1888, 1883, 1898); Hornbeck et al. (2025). Control variables come from the 1860 federal population census (Ruggles et al., 2024).

Table A3: Effect of the Civil War Shock on the Cotton Textiles Industry - Robustness to Functional Forms

			Separating Margins (Chen and Roth, 2024)			Power Functions (Thakral and Tô, 2026)		
	(1) $\mathbf{1}\{y>0\}$	(2) $\log(1+y)$	(3) m(y): x = 0	(4) m(y): x = 1	(5) m(y): x = 3	(6) x = 1/6	(7) x = 1/5	(8) x = 1/4
Cotton Industry x 1837	-0.01	-0.04	-0.02	-0.03	-0.06	-0.03	-0.03	-0.05
	(0.02)	(0.09)	(0.09)	(0.11)	(0.15)	(0.04)	(0.05)	(0.07)
Cotton Industry x 1845	0.03	-0.00	-0.01	0.02	0.08	0.01	0.00	-0.02
	(0.02)	(0.07)	(0.08)	(0.09)	(0.13)	(0.04)	(0.04)	(0.06)
Cotton Industry x 1865	-0.03*	-0.15***	-0.16***	-0.18***	-0.24**	-0.07***	-0.09***	-0.12***
	(0.02)	(0.05)	(0.06)	(0.07)	(0.10)	(0.03)	(0.03)	(0.04)
Cotton Industry x 1875	0.00	-0.08	-0.09	-0.09	-0.09	-0.01	-0.01	-0.00
	(0.02)	(0.07)	(0.07)	(0.09)	(0.13)	(0.04)	(0.04)	(0.05)
Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Town x Industry FE	✓	✓	✓	✓	✓	✓	✓	✓
Pretrend test (p-value)	0.051	0.828	0.973	0.777	0.407	0.438	0.584	0.735
Dep. Var. Mean	0.203	0.585	0.536	-0.261	-1.854	0.334	0.374	0.447
Observations	39,089	39,089	39,089	39,089	39,089	39,089	39,089	39,089
Towns	330	330	330	330	330	330	330	330

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01. Each column estimates equation 4 where the outcome is a different function form of total manufacturing employment in a given town-industry-year in order to show robustness to the use of the inverse hyperbolic sine transformation in the main result. Column (1) estimates the effect along the extensive margin, while column (2) applies the $\log(1+y)$ transformation. Columns (3)-(5) perform "explicit calibration of the extensive margin" (Chen and Roth, 2024), which applies the transformation $m(y) = \begin{cases} \log(y) & y > 0 \\ -x & y = 0 \end{cases}$ for the given values of x in order to estimate the ATT by making the tradeoff along the extensive and intensive margins explicit. Columns (6)-(8) apply power function transformations with the given exponent as recommended by Thakral and Tô (2026). Standard errors are clustered by town.
Sources: Outcomes and weights from Commonwealth of Massachusetts (1838, 1846, 1856, 1866); Massachusetts Bureau of Statistics of Labor (1877, 1883).

Table A4: Effect of the Civil War Shock on the Cotton Textiles Industry in Massachusetts - Sant'Anna and Zhao (2020) Estimates

	Value of Output (IHS)		Employment (IHS)	
	(1)	(2)	(3)	(4)
Cotton Industry x 1837	-1.09***	-0.55	-0.54***	-0.83***
	(0.26)	(1.18)	(0.11)	(0.37)
Cotton Industry x 1845	0.20	1.07	0.03	0.06
	(0.22)	(1.18)	(0.09)	(0.44)
Cotton Industry x 1865	-0.16	0.47	-0.10	-0.02
	(0.18)	(0.92)	(0.06)	(0.22)
Cotton Industry x 1875	-0.01	0.86	-0.13	0.05
	(0.23)	(1.35)	(0.09)	(0.32)
Overall ATT	-0.08	0.67	-0.11*	0.02
	(0.18)	(1.14)	(0.07)	(0.27)
Pretrend test (p-value)	0.000	0.173	0.000	0.015
Dep. Var. Mean	2.150	2.150	0.695	0.695
Observations	38,847	38,609	38,968	38,734
Towns	330	327	330	327
Controls		✓		✓
Weights		✓		✓

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Event study using doubly-robust differences-in-differences (Sant'Anna and Zhao, 2020) with R package `did` (Callaway and Sant'Anna, 2021). Controls are the town's percent foreign born and an urban dummy (population $>$ 2500); weights are 1855 town manufacturing employment. Significance stars determined using bootstrapped simultaneous confidence bands with clustering by towns.

Sources: Outcomes and weights from Commonwealth of Massachusetts (1838, 1846, 1856, 1866); Massachusetts Bureau of Statistics of Labor (1877, 1883). Control variables come from the 1860 federal population census (Ruggles et al., 2024).

Table A5: Effect of the Civil War Shock on the Cotton Textiles Industry in Massachusetts – All Data Years Included

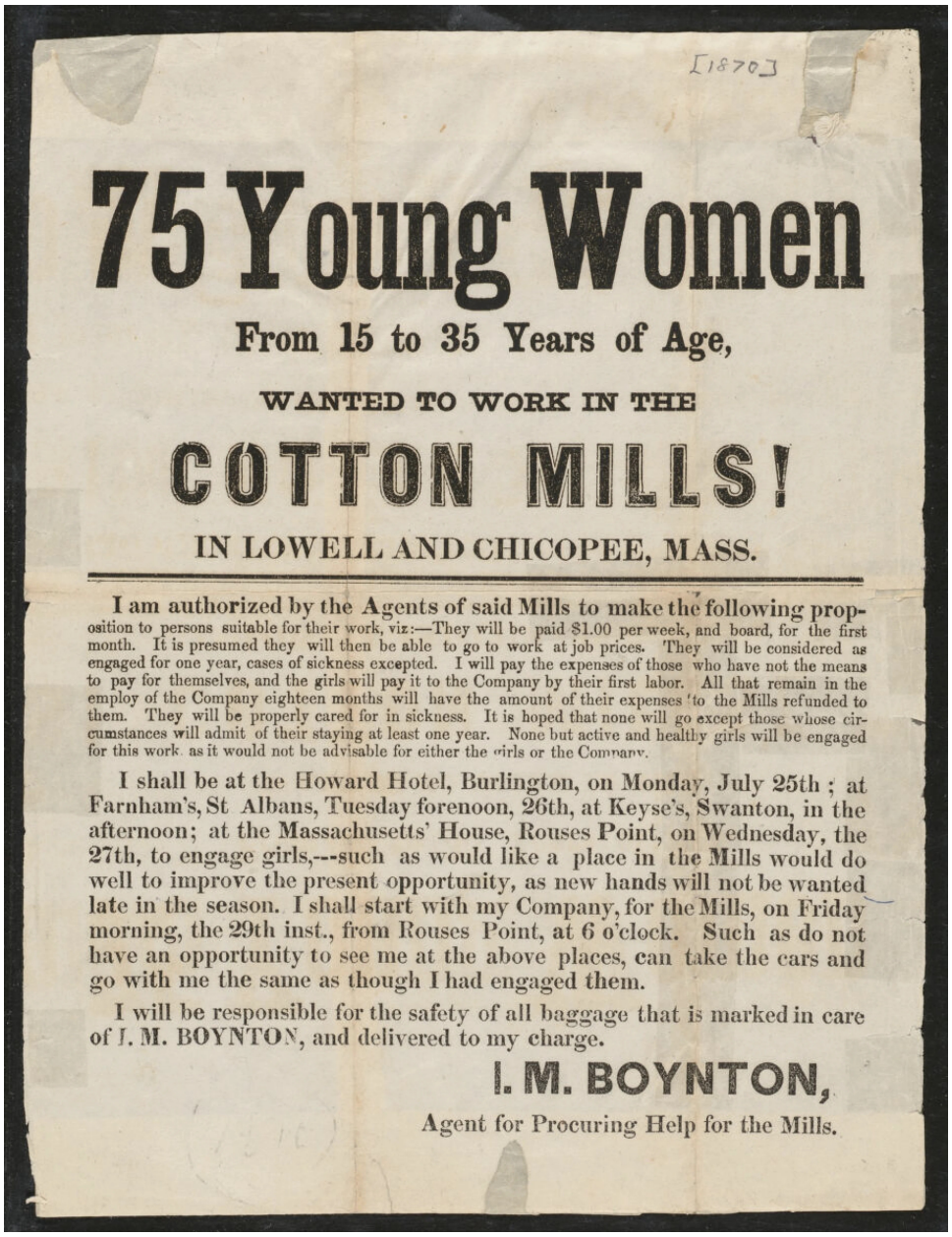
	Log Output		Log Employment	
	(1)	(2)	(3)	(4)
Cotton Industry x 1837	-0.17	-0.15	0.17	0.22
	(0.27)	(0.40)	(0.19)	(0.27)
Cotton Industry x 1845	-0.02	-0.30	0.01	-0.04
	(0.18)	(0.20)	(0.16)	(0.15)
Cotton Industry x 1850	0.01	-0.49	0.13	-0.15
	(0.16)	(0.31)	(0.14)	(0.20)
Cotton Industry x 1855	-0.32**	-0.72***	-0.15	-0.39***
	(0.14)	(0.19)	(0.13)	(0.14)
Cotton Industry x 1865	0.33*	0.02	-0.47***	-0.70**
	(0.17)	(0.43)	(0.13)	(0.33)
Cotton Industry x 1875	-0.06	-0.24	-0.08	-0.00
	(0.20)	(0.33)	(0.17)	(0.32)
Cotton Industry x 1880	-0.04	-0.35	0.06	-0.05
	(0.24)	(0.39)	(0.18)	(0.30)
Cotton Industry x 1885	-0.39*	-0.72	-0.23	-0.44
	(0.21)	(0.48)	(0.21)	(0.44)
Cotton Industry x 1895	-0.22	-0.45	-0.09	-0.15
	(0.27)	(0.51)	(0.27)	(0.45)
Year FE	✓	✓	✓	✓
Town x Industry FE	✓	✓	✓	✓
Controls x Year		✓		✓
Weights		✓		✓
Pretrend test (p-value)	0.114	0.004	0.191	0.032
Dep. Var. Mean	11.428	11.432	4.115	4.117
Observations	5,769	5,757	5,721	5,710
Towns	323	320	323	320

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Estimation of town-industry-year regressions of the given manufacuturing outcome on a cotton textiles industry indicator interacted with a full set of year indicators, along with the noted fixed effects, controls, and weights (equation 4). Controls are the town's percent foreign born and an urban dummy (population > 2500); weights are 1855 town manufacturing employment. Only town-industries with at least three establishments are included to provide consistent coverage across years as the 1885 and 1895 state censuses censored data in this way. Standard errors are clustered by town.

Sources: Outcomes and weights from Commonwealth of Massachusetts (1838, 1846, 1856, 1866); Massachusetts Bureau of Statistics of Labor (1877, 1888, 1883, 1898); Hornbeck et al. (2025). Control variables come from the 1860 federal population census (Ruggles et al., 2024).

C.3 Mechanisms

Figure A5: Recruitment Poster for the Boston Manufacturing Company, 1870



[1870]

75 Young Women

From 15 to 35 Years of Age,

WANTED TO WORK IN THE

COTTON MILLS!

IN LOWELL AND CHICOPEE, MASS.

I am authorized by the Agents of said Mills to make the following proposition to persons suitable for their work, viz:—They will be paid $1.00 per week, and board, for the first month. It is presumed they will then be able to go to work at job prices. They will be considered as engaged for one year, cases of sickness excepted. I will pay the expenses of those who have not the means to pay for themselves, and the girls will pay it to the Company by their first labor. All that remain in the employ of the Company eighteen months will have the amount of their expenses to the Mills refunded to them. They will be properly cared for in sickness. It is hoped that none will go except those whose circumstances will admit of their staying at least one year. None but active and healthy girls will be engaged for this work, as it would not be advisable for either the girls or the Company.

I shall be at the Howard Hotel, Burlington, on Monday, July 25th; at Farnham's, St Albans, Tuesday forenoon, 26th, at Keyse's, Swanton, in the afternoon; at the Massachusetts' House, Rouses Point, on Wednesday, the 27th, to engage girls,---such as would like a place in the Mills would do well to improve the present opportunity, as new hands will not be wanted late in the season. I shall start with my Company, for the Mills, on Friday morning, the 29th inst., from Rouses Point, at 6 o'clock. Such as do not have an opportunity to see me at the above places, can take the cars and go with me the same as though I had engaged them.

I will be responsible for the safety of all baggage that is marked in care of I. M. BOYNTON, and delivered to my charge.

I. M. BOYNTON,

Agent for Procuring Help for the Mills.

Source: Boston Manufacturing Company Records, Harvard University Baker Library.