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WOMEN, CHILDREN, AND INDUSTRIALIZATION IN THE EARLY REPUBLIC: EVIDENCE FROM THE MANUFACTURING CENSUSES

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ABSTRACT

The first half of the nineteenth century was a critical juncture regarding the emergence of female participation in the market economy, the increase in the wage of females relative to that of adult males, and the evolution of large scale firms in both mechanized and non-mechanized industries. We present the first systematic and comprehensive description of these events as they evolved in the states of the Northeast to 1850. Our sources are primarily samples taken from three early censuses and reports of manufacturing, 1820, 1832, and 1850.

Our principal findings are: (1) that women and children composed a large share (over 40% in 1832) of the entire manufacturing labor force during the initial period of industrialization in the U.S., but that this share began a secular decline as early as 1840; (2) that the wage of females (and boys) relative to that of adult males rose wherever large scale manufacturing establishments spread and that by 1850 this ratio had risen to almost 90% its long-term level; (3) that the labor force participation of young unmarried women in the industrial counties of the Northeast was, in 1832, high by late nineteenth century standards; and (4) that the employment of females and boys was closely associated with production processes used by large-scale establishments. Women and children had been a previously under-utilized and large segment of the potential labor force, and their harnessing by manufacturing was a critical factor in the industrialization of the Northeast.

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> The first objection [the dearness of labor] ceases to be formidable when it is recollected how prodigiously the proportion of manual labor in a variety of manufactures has been decreased by the late improvements in the construction and application of machines -- and when it is also considered to what extent women and children in the populous parts of the country may be rendered auxiliary to undertakings of this nature.
>
> Prospectus of the Society for Establishing Useful Manufactures, undoubtedly drafted by Hamilton (1791?) from Arthur Harrison Cole, Industrial and Commercial Correspondence of Alexander Hamilton, (Chicago, 1928).

I

It has long been argued that during the early phase of industrialization in America, manufacturers grappled with ways to reduce the cost of labor. An abundance of agricultural land has been viewed as contributing to the development of labor-saving and capital-intensive technologies in the U.S., by serving to establish a high price for unskilled male labor. It has been less widely acknowledged that American industry also responded to the high relative price of adult males by adapting its organization of work to utilize alternative sources of labor provided by women (generally young and unmarried) and children. [1] Previous studies have focused on the employment of women and children in the highly mechanized textile industry. But women and children also constituted substantial proportions of the labor forces of many other industries which did not experience significant mechanization prior to 1850. [2] The technologies of these industries were altered in yet other ways, which produced a more intricate division of labor within the firm, a more disciplined work regime, and a larger scale of operation. Our central theme is that the spread of all these technologies greatly facilitated the substitution of unskilled for skilled labor and in particular accounted for the substantial increase in the employment of women and children, which extended

across much of the northeastern manufacturing sector. We also explore the impact of industrialization on the labor force participation rates of females and children and their wages relative to those of adult men during the first half of the nineteenth century.

We will argue that the employment of women and children evolved rapidly during the period of industrialization in the two decades prior to 1832. Spurred by the interruptions in foreign trade, among other factors, the manufacturing sector expanded greatly, as did the scale of individual manufacturing enterprises. The proportion of the northeastern manufacturing labor force composed of females and young males seems likely to have grown from about 10% early in the century to over 40% by 1832. This share was maintained for at most a decade, but the relative growth of industries intensive in male labor, competition from unskilled male immigrants, the increase in the relative wage for women and children, and further technological developments each may have contributed to a secular decline in the proportion of the manufacturing labor force composed of women and children.

It should not be surprising that northern manufacturers were initially quick to adopt production methods that relied extensively on the employment of women and children. The low relative productivity of these workers in the North's agricultural sector, where hay, dairy goods, and grains were the major products, had established a relatively low opportunity cost for their labor. Wherever the manufacturing sector expanded, the wages of women and children were bid up substantially, both in absolute terms and relative to those of males. During the brief period from 1820 to 1850 the ratio of the female to the adult male wage in manufacturing rose to almost 90% the value it achieved from 1885 to 1960, when it was relatively stable. The rise in manufacturing employment of females was also associated with an equally impressive advance in their rate of labor force participation. Thus the first half of the nineteenth century was a critical juncture in

the evolution of both female participation in the market economy and the relative wage of females in the manufacturing sector. We present the first systematic and comprehensive description of these events as they evolved in the states of the Northeast to 1850.

In a related paper we develop a simple general equilibrium model that connects some of the changes we more thoroughly document in this article.[3] While we will not formally discuss the details of this model, we will make references to them . We have the following sort of model in mind throughout our analysis. Consider the simplest of all variants of a general equilibrium model: a two sector (agriculture and manufacturing), two input (female plus child labor and male labor) model, in which agriculture is relatively intensive in male labor at all factor price ratios, and endowments and output prices are exogenously determined. Initially, perhaps around 1800 before the growth of manufacturing establishments, the relative wage for females and children compared to that for adult men was quite low. Production techniques in the manufacturing sector would not yet have been explored to utilize female (and child) labor, which may differ from male labor objectively in terms of skill, experience, dexterity, and strength, or subjectively in terms of cultural norms. During the period, say from 1810 to 1830, the range of production possibilities in the manufacturing sector is increased, and with it the proportion of females employed in manufacturing, the proportion of the manufacturing labor force that was female, and the relative wage of females (w_f/w_m). From 1830 to 1850 further changes, perhaps in the form of neutral technical change in manufacturing, continue to exert upward pressure on (w_f/w_m) and on the proportion of all females in manufacturing, but the female share of the manufacturing sector labor force declines.

Thus our conception of the first half of the nineteenth century is one of two stages. The initial transition, from small artisan (male intensive) shops to larger (female intensive) factories, could have involved a search along an isoquant. While physical capital accumulation may have been the force behind this transition in certain industries, it was not universal in its influence. After this initial shift in the organization of work, later changes can be modeled as involving only neutral technical change in the manufacturing sector. [4]

The widely held notion that the early censuses of manufacturing were markedly deficient has limited our knowledge about various aspects of the initial phase of industrialization. While these sources have numerous flaws, their overall value has been vastly underrated, and although they have been utilized by many economic historians, they have not previously been sampled systematically. [5] We have relied extensively on samples drawn from three of them: the 1820 schedules of the Federal Census of Manufactures; a survey of manufacturing firms conducted by the Treasury Department, known as the 1832 McLane Report; and the 1850 schedules of the Federal Census of Manufactures. [6]

II

Available evidence on the allocation of the labor force indicates that the process of industrialization was well under way in the northeastern states by the third decade of the nineteenth century, but a detailed record does not begin until 1840 or later. [7] The composition of the industrial labor force is one of the subjects about which information has been lacking. Descriptions of the early industrial labor force in the Northeast have always pointed to the prominance of females and children in particular industries and in particular regions. But a comprehensive estimate of their representation in the manufac-

turing labor force and its correlates could not be undertaken without the recently collected samples of manufacturing firm data.

These bodies of evidence reveal that a large proportion of the entire industrial labor force across the Northeast was composed of women and children. Our estimates, presented in Table 1, indicate that the percentage of all manufacturing workers composed of these groups in the Northeast achieved an historical peak of over 40% (32.4% + 8.5%) during the initial phase of industrialization. Their fraction of the industrial labor force in the Northeast had already exceeded 30% (8.9% + 23.1%) by 1820 and still remained over that level by 1850, despite having begun a long-term decline. Thus the substantial representation of women and children in the manufacturing labor force seems to have developed quite early and rapidly during the first half of the nineteenth century, but then began a secular decline into the second half.

By focusing only on the data for females of all ages in Table 1 an even clearer pattern emerges. In the Northeast in 1832, 32.4% of the entire manufacturing labor force was composed of females, but by 1850 it had dropped to 28.9%, if one includes the category 'clothiers and tailors' and to 24.1% if one does not. 'Clothiers and tailors' seem to have been overcounted in 1850 relative to both the 1832 report and the 1860 census, and it seems likely that home sewers were included in the 1850 figures (see footnote d, Table 1). A similar trend is apparent in the Massachusetts data, which also include a figure for 1837. Whether one includes home workshop production or not, the percentage of the manufacturing labor force composed of females peaks sometime after 1837 but before 1850. We explore the sources of the decline in the female employment share of northeastern manufacturing in Section IV.

While the figures in Table 1 both for the second half of the nineteenth century and for Massachusetts over the entire period, have been computed in a

TABLE 1

Female and Child Workers as a Percentage of All Workers in Manufacturing: 1820 to 1890

Year	Entire U.S. or Northeast			Massachusetts		
	Females		Children Boys and Girls [Boys]	Females		Children Boys and Girls [Boys]
	All Ages	> 15 Years		All Ages	> 15 Years	
1820 Northeast[a]		8.9	23.1			
1832 Northeast[b]	32.4		[8.5][e]	(38.4-47.5)[f]		[9.3][e]
1837				(41.6-49.0)[f]		
1850 Northeast[c]	28.8(24.0)[d]					
1850 U.S.[c]	24.7(20.1)[d]			39.3(36.2)[d]		
1860 Northeast[c]	28.0					
1860 U.S.[c]	21.1			35.9		
1870 U.S.		15.8	5.6		30.9	5.1
1880 U.S.	21.4	19.5	6.7	32.0	30.1	5.0
1890 U.S.	18.7	18.0	2.6	29.3	28.6	1.8

[a] In calculating these estimates we assumed that, within size categories of firms, the distribution of the labor force among the industries was correct, but made adjustments for the under-enumeration of small firms (or the unrepresentative distribution of the labor force among size categories). Instead of accepting the figures from the sample of 14% of the labor force in the small category (1 to 5 employees), 23% in the medium (6 to 15 employees), and 64% in the large (over 15 employees), we employed 40%, 40%, and 20% in the respective size classes to prepare the reported estimate. See also footnote 9.

[b] These figures were computed under the assumption that the same proportion of children working for firms that failed to enumerate them separately by sex were female, as was the case with those children working for firms of the same industry and size class that did enumerate them separately. The same method of adjusting for the under-enumeration of small firms that was used in calculating the 1820 estimates has been employed here. We assumed that 25% of the labor force was employed by small firms, 25% by the medium-sized firms, and 50% by the large firms. The distribution observed in the 1850 sample of firms, which slightly under-represents large firms because the Rhode Island manuscripts were destroyed, is 18%, 15%, and 68% in the respective size categories. See also footnote 9.

[c] The figure for New England is 37.0 and that for the Middle Atlantic, 22.2 for 1850; comparable figures for 1860 are 35.2 and 22.4. Employment in fisheries, mines, and quarries has been excluded for comparability with other years.

[d] The numbers in parentheses exclude clothiers and tailors, a category that was undoubtedly undercounted in 1832. The 1860 Census of Manufactures was the first to include a category for a clothing industry. The figures for 1860 indicate only a slight rise in total employment in clothing from 1850, when only clothiers and tailors were counted, to 1860, thus raising the possibility that the 1850 figures overcounted home sewers.

[e] These figures include only boys.

[f] The first figure includes only manufacturing workers in shops and factories; that is, it excludes fisheries and palm leaf and straw hat workers. The second figure includes palm leaf and straw hat workers. The number of these workers is given by: $L = [V(2/3)/90]$ where V is the value of output in this industry. This calculation is explained in Table 9, notes to column (4). These figures slightly understate the percentage female because small industries did not enumerate employees by sex. It was assumed, however, for the case of printed cloth that women were 75% of the labor force, which was their percentage in cotton textiles. Workers in the fishing and whaling industry were not included in the total figures.

Notes: The term "children" was used in the Census of Manufactures in 1820 without a clear definition. In several cases enumerators indicated that they included children up to 17 years old in this category. The 1870 through 1890 censuses make clear that "children" meant boys $\leq$ 16 years and girls $\leq$ 15 years. There has been much confusion over the 1850 and 1860 returns, but the manuscripts of the 1850 Census of Manufactures imply that "all females" and "all males" were the categories used. We have used these definitions despite the fact that the 1880 printed census, Vol. 2, reports that the 1850 and 1860 censuses counted only adults. The 1880 and 1890 figures for adult females, all ages, assume that 28.9% of all children in manufacturing were female. Those for Massachusetts used 38.8%. These percentages were derived form the occupations given in the 1880 Census of Population, in Report on the Manufactures of the U.S. at the 10th Census, Vol. 2 (1883), p. xxx.

Sources:
1820: Census of Manufactures
1832: McLane Report
1837: John P. Bigelow, Statistical Tables Exhibiting . . . Industry in Massachusetts for . . . 1837 (Boston, 1838).
1850-1880: Report on the Manufactures of the U.S. at the 10th Census, Vol. 2, pp. 5-8.
1890: Census of Manufactures.

straightforward manner, those reported for the years most critical to our findings, 1820 and 1832, are drawn from a set of estimates. These estimates have been constructed by varying several assumptions about the severity of particular sample selection biases that afflict the underlying sources. Extensive sensitivity tests indicate that our qualitative findings are not affected by variations in these assumptions over a plausible range. [9]

Comparable labor force estimates cannot be constructed for females and children in the pre-1820 economy. Nevertheless, it seems likely that their prominence in the manufacturing labor force around 1820 was a recent development. Women and children may have been active in household manufacturing, but few seem to have labored in the small manufacturing firms (typically with fewer than five workers) that generally characterized the proto-industrial economy, as will be seen in Table 3. Larger enterprises were not established in significant numbers until the burst of industrial expansion ushered in by the Embargo of 1807 and the War of 1812, and it was probably during this period that the proportion of manufacturing workers composed of females and children began to increase substantially. [10]

Cotton and wool textiles were among the first manufacturing industries to experience rapid and substantial increases in output during the early nineteenth century. It should thus not be surprising that the growth of these two industries, both known to utilize female and child labor intensively, accounted for much of the initial increase in the employment of these groups. Indeed, in 1820, not long after industrial expansion had begun, nearly 70% of the adult females in the manufacturing sector labored in the textile industries (as indicated in Table 2). The concentration of females and children in textiles does not, however, indicate that firms in other industries had labor forces that were

TABLE 2

Industrial Distribution of Female Manufacturing Workers: 1820 to 1890

Year; Region	Industry: Textiles Cotton	Wool	Clothing	Other	Age Category of Included Females
1820 Northeast	58.1%	11.8%	2.4%	27.7%	Adults
1837 Massachusetts	39.5	8.6	7.8	44.1	All ages
1850 Massachusetts	29.1	7.0	18.3	45.6	All ages
1850 Northeast	27.1	7.1	31.0	34.8	All ages
1850 U.S.	38.5		34.9	26.6	All ages
1860 U.S.	40.7		33.5	25.8	All ages
1870 U.S.	39.1		28.6	32.3	All ages
1880 U.S.	38.5		32.2	29.3	> 15 years
1890 U.S.	32.2		34.3	33.5	> 15 years

Sources: 1820: Sample from the schedules of the Census of Manufactures.
1837: . . . Industry of Massachusetts
1850: Massachusetts figures from Federal Census of Manufactures
1850 to 1890: Helen Sumner, Woman and Child Wage Earners, Vol. 9: History of Women in Industry in the U.S., Senate Documents, 61st Congress, 2nd Session, Vol. 64 (Washington, D.C., 1910), p. 250, with revisions as in note.

Note: Sumner's 1850 to 1890 clothing employee figures were revised to exclude workers in boots and shoes, umbrellas, and pocketbooks. All the clothing figures include workers in hats and caps, but workers in straw bonnets and palm leaf hats have been excluded from the 1832 and 1837 Massachusetts figures.

As noted in the text, the 1820 Census of Manufactures had poor coverage of manufacturing firms in some areas and generally under-enumerated small establishments. Since small firms employed very few females, their under-representation should not greatly bias these figures.

composed primarily of adult men. It reflects, instead, the large share of the total industrial labor force accounted for by cotton and woolen textiles. As industrialization proceeded, other manufacturing industries grew relative to textiles, reducing the proportion of female workers in textiles to 34% by 1850. [11] Although less intensive in female and child labor than textiles, many of the other prominent industries of this period (e.g. boots and shoes, paper) had large fractions of their workforce composed of these classes of workers. [12] Thus, the high proportion that women and children comprised of manufacturing workers was not merely a product of the hiring of one or two industries, and it continued for some time in the face of a relative decline of textiles among all manufacturing industries.

The estimates of the percentage of manufacturing employees that were women or children, by industry and size of firm, presented in Table 3 provide further evidence that these groups were a major component of the labor force in many industries other than textiles, especially in larger establishments. Among the establishments in the larger size class (over 15 workers), roughly 54% of the employees were women or children in 1820, 59% were in 1832, and over 40% were in 1850. Even excluding the four industries listed separately in Table 3, each of which relied extensively on female and child labor, women and children continue to account for well over 20% of the workers in each of the three years.

The data also suggest that, within industries, as the size of a firm or its scale of production increased, so did the proportion of the firm's workforce made up of women and children. In the 1850 boots and shoes industry, for example, only 7.8% of the workers in small firms (1 to 5 workers) were female, while 24.1% and 41.5% of those in intermediate (6 to 15 workers) and large size classes respectively were. Only very few industries do not conform to this general pattern. While one might question whether the observed relationshiop between size of firm and labor composition is a product of other variables correlated

TABLE 3

Proportion of Females and Children in the Northeastern Labor Force by Selected Inudstries and by Size of Firm: 1820, 1832, and 1850

	Total Number of Employees in Firm: Small (1 to 5 Employees)		Medium (6 to 15 Employees)		Large (≥ 16 Employees)	
	% Females	% Children [% Boys]	% Females	% Children [% Boys]	% Females	%Children [% Boys]
1820						
Cotton Textiles (52.1%)	27.8	16.7	32.4	46.4	28.9	50.2
Wool and Mixed Textiles (12.5%)	4.5	15.0	17.0	37.3	19.3	41.1
Shoes and Boots (2.2%)	16.7	5.6	21.1	11.8	21.0	6.0
Paper (5.6%)	--	--	19.1	36.1	36.8	23.5
Other Industries (27.6%)	0.9	11.8	4.7	22.5	6.7	20.4
Total (100.0%)	1.7	12.2	11.1	28.2	19.1	34.6
1832						
Cotton Textiles (57.5%)	--	--	70.1	[12.6]	73.4	[7.3]
Wool and Mixed Textiles (14.6%)	13.2	[14.6]	31.3	[9.3]	47.1	[8.9]
Shoes and Boots (12.9%)	25.0	[3.1]	30.3	[9.7]	44.5	[11.3]
Paper (1.6%)	10.5	[2.6]	41.1	[3.0]	47.1	[4.6]
Other Industries (13.5%)	1.6	[5.7]	11.5	[13.5]	18.5	[7.8]
Total (100.0%)	5.2	[6.3]	23.7	[11.1]	50.4	[8.2]

(Table 3, continued)

	Small % Females	Medium % Females	Large % Females
1850			
Cotton Textiles (27.1%)	33.3	--	63.8
Wool and Mixed Textiles (8.0%)	16.0	33.9	46.5
Shoes and Boots (15.9%)	7.8	24.1	41.5
Paper (1.2%)	13.8	22.5	57.7
Other Industries (47.8%)	2.6	7.7	19.3
Total (100.0%)	3.7	11.9	32.6

Notes and Sources:

These percentages were computed from the samples of manufacturing firms drawn from the 1820 and 1850 Censuses of Manufactures and the 1832 McLane Report. The figures in parentheses report the unadjusted percentage of female and child workers (only females in 1850) in that industry. In the 1820 figures, "females" include only adult women, probably over 16 years. In the 1850 figures, "females" include females of all ages. McLane Report enumerators typically grouped females of all ages in a separate category, although some firms reported boys and girls together. The above figures were computed by assuming that firms that combined boys and girls had the same ratio of girls to boys as did other firms in the same industry and size class. Thus, the 1832 "children" percentages should be interpreted as the percentages of boys, not all children.

The McLane Report, with the exception of Massachusetts, generally undercounted small manufacturing firms, and this sample selection bias was especially severe for New York and Rhode Island, in which establishments other than large-scale textile firms were virtually excluded. As a consequence, the size distribution of firms from our 1832 sample is skewed toward the larger firms, and textile firms are over-represented. These biases however, do not necessarily affect the data in this Table, which is stratified by both size class and industry.

separately with these, the regressions appearing in Table 4 indicate otherwise. Even after controlling for variables such as region, level of urbanization, and industry, the size of a firm remains a powerful predictor of the proportion of its labor force composed of women and children. The coefficient on the log of the number of employees is significant to the 1% level in each of the three samples of manufacturing firms (1820, 1832, and 1850) analyzed.

The finding that larger firm size was associated in many industries with a higher proportion of female and child employees suggests that the displacement of artisan shops by establishments organized as factories served to increase the share of these groups in the manufacturing labor force. The statistical relationship indicates some of the consequences of the utilization of the factory system, and also bears on why such methods of production were increasingly adopted during the early phase of industrialization. Advances in mechanization are frequently acknowledged to have contributed to the increased utilization of females and children, but many non-mechanized industries also experienced similar changes in firm organization. Habakkuk has argued that the diffusion of the new technologies was at least partially the outcome of vigorous efforts by American manufacturers to conserve on the utilization of male labor. But the methods that could have served to accomplish this goal were many, among them the substitution of capital for labor, the use of available labor supplies more intensively (increasing the pace of production), and the substitution of a relatively cheap class of workers for an expensive one. [13]

The relationship between firm size and the employment of women and children within industries indicates that the diffusion of new, large-scale technologies was associated with the substitution of women and children for men. In some industries, such as textiles and paper, these new technologies were capital intensive, but other industries seem also to have altered their production methods,

TABLE 4

Explaining the Percentage of the Firm's Labor Force Composed of Females and Boys: 1820, 1832, and 1850

	1820 (Females + Boys) Number of Employees	1832 (Females + Boys) Number of Employees	1850 Females Number of Employees
Intercept	0.296	0.223	0.136
	(7.15)	(5.31)	(5.00)
Log(% of County Population Residing in Urban Area)	-0.003	0.018	0.008
	(-0.84)	(1.92)	(1.22)
Log (Number of Employees)	0.088	0.067	0.058
	(12.57)	(10.92)	(16.58)
New England Dummy	0.029	0.035	0.038
	(1.76)	(1.94)	(4.90)
Industry Dummies:			
Cotton	0.179	0.310	0.136
	(4.30)	(7.86)	(3.39)
Wool	-0.092	0.013	
	(-2.23)	(0.34)	
Iron	-0.475	-0.386	-0.275
	(-9.66)	(-8.93)	(-7.70)
Iron Products		-0.232	
		(-3.84)	
Tanneries	-0.194	-0.225	-0.206
	(-4.64)	(-5.50)	(-6.74)
Mills	-0.297	-0.239	
	(-6.64)	(-3.98)	
Harnesses and Coaches		-0.218	
		(-4.63)	
Shoes		0.016	-0.109
		(0.39)	(-4.01)
Household Goods			-0.210
			(-7.01)
Perishables			-0.167
			(-5.14)

TABLE 4 (Cont'd)

	1820 (Females + Boys) Number of Employees	1832 (Females + Boys) Number of Employees	1850 Females Number of Employees
Construction			-0.201 (-7.47)
Hand Trades			-0.190 (-6.78)
Miscellaneous	-0.19 (-5.70)	-0.166 (-4.55)	-0.146 (-5.62)
R^2	0.561	0.605	0.325
Number of Firms	1036	940	1652

Notes and Sources:

The intercept, for the 1820 and 1832 regressions, represents a paper mill in the Middle Atlantic. The 1850 intercept reflects a Middle Atlantic firm in the wool industry.

These regressions were estimated across all firms in the 1820, 1832, and 1850 samples that reported the necessary information. The definition of the dependent variable and the set of independent variables varied somewhat from census to census. The 1850 regression uses [females/employees] as the dependent variable because boys were not separately enumerated from men, and each regression uses a different set of industry dummies. Several industry dummies included in the 1820 regression have been omitted to conserve space.

utilizing a more extensive division of labor within the firm, without significantly increasing capital intensity. [14] The separation of tasks within the firm appears to have occurred across a wide range of industries, and studies of industries as dissimilar as glass and shoes have suggested that such changes in work organization were introduced to economize on costly skilled labor:

> When window glass was just manufactured in the United States, it was customary not only for the blower to gather his own glass but also to blow, cut, and flatten it. In 1820 this was still common in many of the smaller factories. Those operated on a larger scale frequently had assistants or apprentices who relieved the blowers of certain of the more minor and unskilled steps of the process. In time the division of labor was greatly elaborated; four separate trades eventually emerged from the process of making cylinder window glass.[15]

> He [Gideon Howard, a manufacturer of shoes in South Randolph, Massachusetts] had a "gang" over in his twelve-footer who fitted, made and finished: one lasted, one pegged and tacked on soles, one made fore edges, one put on heels and "pared them up," and in case of handsewed shoes, two or three sewers were needed to keep the rest of the gang busy. . . . these groups of men in a ten-footer gradually took on a character due to specialization demanded by the markets with higher standards and need of speed in output. Instead of all the men working there being regularly trained shoemakers, perhaps only one would be, and he was a boss contractor, who took out from a central shop so many cases to be done at a certain figure and date, and hired shoemakers who had "picked up" the knowledge of one process and set them to work under his supervision. One of the gang was a laster, another a pegger, one an edge-maker, one a polisher. Sometimes, as business grew, each of these operators would be duplicated. Such work did away with the old seven-year apprenticeship system.[16]

Because females and boys were generally enumerated separately from adult males, the substitution of women and children for men in the larger establishments may only be one easily observed aspect of a more general phenomenon, the substitution of unskilled labor for skilled labor. The small manufacturing shops of the period typically consisted of a few artisans, perhaps with an

apprentice, and the limited division of labor within such firms allowed only a small fraction of their employees to be unskilled. Larger firms were more likely to have implemented an organization of work that involved a separation of tasks and allotted a greater share of positions to unskilled workers. The definition of "unskilled" is a matter of degree, and it is perhaps an over-simplification to use sex and age as proxies for skill. [17] While women and children did accumulate skills on the job, their limited job training, actual and anticipated in the case of females, led them to have acquired fewer skills than did adult men. Indivisibilities associated with the application of a supervisory input may also have contributed to the increase in females and children with the scale of firms. The productivity of these laborers, particularly the young, could have been disproportionately affected by the addition of supervision, either through an improved coordination of the efforts of workers, through a more intense pace of work, or through the use of piece-rate wages, among other methods of ensuring a disciplined work regime. [18]

III

We have argued that the initial phase of industrialization in the U.S. was characterized not only by a great expansion of the manufacturing sector in the Northeast, but also by a shift to the factory system and toward technologies utilizing an extensive division of labor within the firm. Why both of these developments occurred during the early nineteenth century is an issue of great complexity and beyond the scope of this work. But it is clear that many factors, such as technological change, economies of scale, tariffs, falling transport costs, and more efficient capital markets could each have played a significant role.[19] Given any combination of events sufficient to stimulate a shift toward large-scale

production methods, however, manufacturers in a region where female and child labor were relatively cheap would have had a great incentive to adopt such methods. Similarly, if one compares across industries at given factor price ratios, the industry that was most intensive in female and child labor would be most likely to locate in a region with an initially low ratio of female to adult male wages. [20] Population density might also have been a critical factor since the drawing off of a substantial labor force from a sparsely populated hinterland would have been more costly. [21]

Wage rate data for women and children prior to the industrialization of the Northeast are scarce, and even when such data are found, they have often already been affected by the quick upward response of female and child wages that occurred when opportunities for work in manufacturing establishments became available. [22] While we have some data bearing on agricultural wage rates prior to industrialization, our best evidence on the pre-industrial period comes from the commentary of those who lived through these transitionary times. Bodies of evidence such as the censuses of manufactures allow us to compute estimates for the ratio of the female wage to that of adult males at several points during the early industrialization of the Northeast. While other sources for wage rates exist for certain industries, these censuses enable us to compute estimates of the average wage across the entire manufacturing sector. All available evidence we have located confirms our assumption that the wage rate estimates from our 1832 and 1850 samples represent average wages for a particular group of laborers in a particular firm. [23]

Our estimates of the relative wage of females to adult males for pre-industrial New England and for New England and the Middle Atlantic during early industrialization are presented in Table 5. [24] Wage ratios in the pre-industrial Northeast were significantly lower than were those prevailing in the same region after industrial

development, and the wage rates of females were bid up substantially relative to those of adult males during the initial period of industrialization. We estimate that the ratio of the female to adult male wage rate in manufacturing increased in New England from 0.37 in 1820 to 0.46 by 1850. But the increase in this wage ratio within manufacturing is dwarfed by its increase as the region moved from agriculture to industry, an increase from 0.29 to 0.46 . In the Middle Atlantic, the increase within the manufacturing sector was even more substantial, rising from 0.30 in 1820 to 0.51 by 1850 .[25] This 1850 Middle Atlantic level was almost 90% of the ratio of 0.58 achieved by 1885 in manufacturing and roughly maintained at least until 1960 .[26] Because the data in the 1832 and 1850 samples aggregated females of all ages but those beginning with 1870 did not, the rapid increase in the wage ratio during the early period is even more impressive.[27]

Our findings of a rapid and steep increase in this wage ratio are consistent with the observations of many contemporaries of the early nineteenth century who reported that the relative productivity (and wages) of women (and children) compared to adult men was low in the agricultural and traditional sectors of the pre-industrial northeastern economy. For example, Albert Gallatin, previously Secretary of the Treasury, noted in 1831 that:

> female labor employed in manufactures appears from the rate of their wages to be more productive than if applied to the ordinary occupation of women.[28]

A year later, two northeastern manufacturers, surveyed by the McLane Report as to the employment opportunities for children outside manufacturing, responded that: "Children cannot be advantageously employed, and can get no wages" and "children, under sixteen, cannot obtain wages; their board and washing is generally considered of about as much value as their labor (Vol. II, p. 73 and p. 77)." While these observations may suggest the existence of a disequilibrium in the labor market, most respondents to the McLane Report added that wages rapidly adjusted upward in both

TABLE 5

Relative Wages of Females to Males, Prior to and During Early Industrialization

	Middle Atlantic (w_f/w_m)	New England (w_f/w_m)
1815		0.288
1820	0.303 [0.255-0.328]	0.371 [0.321-0.404]
1832(a)	0.411 [0.365-0.487]	0.421 [0.373-0.499]
(b)	0.432 [0.395-0.460]	0.441 [0.404-0.470]
1850(a)	0.524 [0.428-0.630]	0.437 [0.356-0.525]
(b)	0.509 [0.463-0.554]	0.460 [0.419-0.501]

Notes and Sources:

1815: This ratio is computed from information contained in Carrol Wright, Sixteenth Annual Report of the Commissioner of Labor of Massachusetts, (Boston, 1885), which gives 50¢/week for females (employed as domestics) and 86.8¢/day for males (employed in agriculture) without board. The female figure does not appear to include a value for board, and one of $1/week has been assumed. A six-day work week was also assumed in order to calculate the weekly wage for males.

1820: Because the information on wages in the 1820 Census of Manufactures was reported as an annual wage bill for all employees, estimates of the female to male wage ratio were derived from a set of wage regressions, available from the authors, run over the firms contained in the 1820 sample. The procedure used is as follows. Estimates of the wage rates for adult males, adult females, and children were retrieved from the firm data by estimating equation:

$$(1) \qquad \frac{V}{L} = \beta_0 + \beta_1 \frac{L_f}{L} + \beta_2 \frac{L_c}{L} + \sum_i \alpha_i D_i + \varepsilon ,$$

where V = the total wage bill, L = the total number of employees, L_f = the number of adult female employees, L_c = the number of child employees, D_i = a set of industry and regional dummies and interaction terms, and ε = the error term. The general form of equation (1) is derived from the identity:

$$(2) \qquad V = \sum_j L_j w_j \qquad j = m,f,c$$

(Notes and Sources, Table 5, continued)

where w_j = the annual wage rate for the jth class of labor, and the coefficients of equation (1) are estimates of:

$$(3) \qquad \hat{\beta}_0 = \hat{w}_m; \quad \hat{\beta}_1 = (\hat{w}_f - \hat{w}_m); \quad \hat{\beta}_2 = (\hat{w}_c - \hat{w}_m)$$

The intercept of the equation, the base wage of an adult male, must be combined with the contribution of the other appropriate independent variables to compute the estimated wage for the particular class of employees. The male and female wage rates were estimated separately, for several industries, before calculating a set of wage ratios from which males or females were employed, as well as the subset of firms over which the equation is estimated. We have reported the average wage ratio, with the range appearing in brackets below. The wage estimates were computed for an average firm which (depending on the subset of firms) was located in a county with 60% of its labor force in agriculture.

1832(a): The 1832 estimates of the female to adult male wage ratios (w_f/w_m) are derived from wage regressions run over a sample of manufacturing firms drawn from the McLane Report. Adult male and female wages were estimated for a number of industries from the regressions appearing in Table 6, and a set of wage ratios was then computed from them. The wage estimates were calculated from the regression coefficients for a firm with the average number of workers (for that industry), that was located in a county where 40% of the population resided in urban areas. The average wage ratio is reported, with the range of estimates appearing below it in brackets.

1832(b): These ratios utilize the 1832(a) female wage estimates, but are divided by 1832 wage rates for common laborers in Lebergott, Manpower in American Economic Growth. . . , p. 541. The New England estimate is Lebergott's, adjusted for a value of $1.50/week board. Lebergott's estimate of the 1832 wage for common laborers in the Middle Atlantic is, however, implausibly high. It implies that common laborers were paid higher wages than were the employees of most manufacturing industries, and that the nominal wage for common laborers fell in the Middle Atlantic between 1832 and 1850, while rising significantly in New England. Thus, instead of employing Lebergott's estimate of 96¢/day, we use a figure of 75.5¢/day, obtained by two independent methods. We have derived this estimate by applying the New England-Middle Atlantic wage differential from the regressions over manufacturing firms (in percentage terms) to the New England wage for common laborers. In addition, an average of the common laborer wage rates given by Donald Adams, "Wage Rates in the Early National Period: Philadelphia, 1785-1830," Journal of Economic History, XXVIII (Sept. 1968), pp. 404-26, and Jeffrey Zabler, "Further Evidence on American Wage Differentials," Explorations in Economic History, 10 (Fall 1972), pp. 109-17, yields an almost identical estimate.

1850(a): The 1850 estimates of (w_f/w_m) estimates are based on the 1850(a) female wage estimates, but utilize Lebergott's estimates of the wages for common laborers in 1850 for the male wage.

the agricultural and manufacturing sectors. "[T]he manufacturing interest has tended to depress that of the agriculturalist. . .on account of the expense of labor" was the conclusion of an agent in New Hampshire (Vol. I, p. 742), and a correspondent in New York stated that "if those now engaged in the factories were thrown out of employ, wages [in domestic work] would probably be reduced . . . (Vol. II, p. 22)." Further support of our contention that industrial expansion in the Northeast increased the relative wage of women and children is provided by Henry Carey, whose analysis of wage rates written just after the McLane Report revealed that:

> agricultural labor has not varied materially in these forty years [1793 to 1833] in its money price. . . the wages of men having been very steadily about nine dollars per month [with board]. . .[but] the wages of females have greatly advanced being nearly double what they were forty years since. [29]

The agreement between our estimates and the perceptions of early nineteenth century observers would seem to place the finding of an increase in the relative wage of females on a sound basis. One possible explanation of the coincidence of this rise with the increase in the female share of the manufacturing labor force is that the diffusion of new methods of production boosted the relative productivity of women and children in manufacturing, leading to a substitution of such workers for adult males, and a surge in the demand for them. This conjecture can account for the growing proportion of employees that were female within (and across) industries, as well as the increase in the relative wage. It should be emphasized that the expansion of the manufacturing sector alone does not adequately explain the observed phenomena. In a two-sector model in which manufacturing is the sector relatively intensive in female labor, demand induced growth or neutral technical change with exogenously determined output prices, would produce an increase in the relative wage of females, but it would also imply an increase in the male share of the manufacturing labor force. Such a change in

factor proportions in manufacturing did take place, as we indicate in Table 1, after about 1840.

The increase in the relative wage for females and children might be rationalized in ways other than those that are consistent with our explanation, but our evidence does not substantiate these alternative explanations. Workers who migrated to the manufacturing sector from the agricultural (or traditional) sector may have suffered a deterioration in working and ambient conditions for which they had to be compensated. In this view, the relative wages of females and boys increased because these groups required greater compensatory payments, in percentage terms, for laboring in industrial establishments than did adult men. The increase in relative wages rather than being produced by a shifting out of demand for women and children, results here from an inward shift in the supply of such labor. Although differences in the proportion of the wage required for compensation may seem peculiar, it is possible that the labor supply of women and children was more sensitive to working conditions and environment than was that of men.

This conjecture can be investigated by utilizing the information contained in the samples of manufacturing firm data from 1832 to 1850. One should be able to determine the existence and magnitude of such a hypothesized compensation by estimating the relationship between wage rates and working conditions. The chief problem with this approach is the difficulty of obtaining a measure of the conditions for which workers demanded compensatory differentials. We have used the number of employees in the firm and the extent of urbanization in the local county as proxies for working conditions and environment, and regressed the wage for the particular class of employees on these variables and on dummy variables for industry and region.[30]

TABLE 6

Explaining Wage Variation by Manufacturing Firm: 1832

	Log (Adult Male Wage)	Log (Female Wage)	Log (Boy Wage)
Intercept	5.498 (108.49)	4.447 (53.52)	4.523 (32.39)
Log (% of County Population Residing In Urban Area)	0.056 (4.98)	0.004 (0.18)	0.019 (0.67)
Log (Number of Employees)	0.033 (4.27)	0.031 (1.98)	0.028 (1.38)
New England Dummy	0.207 (9.44)	0.230 (5.18)	0.243 (4.26)
Industry Dummies:			
Cotton	0.066 (1.42)	0.094 (1.44)	-0.206 (-1.73)
Wool	-0.112 (-2.49)	0.079 (1.20)	-0.114 (-0.97)
Iron	0.012 (0.24)		0.101 (0.49)
Tanning	-0.144 (-3.00)	0.182 (1.09)	0.080 (0.55)
Shoes	-0.392 (-8.27)	-0.648 (-9.25)	-0.112 (0.89)
Mills	-0.056 (-0.76)		0.435 (1.19)
Other Miscellaneous[a]	0.099 (2.31)	0.076 (1.10)	0.127 (1.08)
R^2	0.374	0.476	0.186
Number of firms	853	414	284

[a]Several statistically insignificant industry dummies have been omitted from the Table.

Three regressions, one each for men, females, and boys were run across the 1832 firm data and are presented in Table 6. Although adult males appear to have earned significantly higher wages in urban areas, the compensation paid to females and boys seems to have been unrelated to urbanization. The contrast suggests that even had the higher wages to men in urban areas represented compensation for a less pleasing environment, the relative wages of females and boys would have fallen as the manufacturing labor force became more concentrated in urban areas. The absence of an urban-rural wage differential among females and boys suggests that the urban wage premium for men was produced by differences in skill levels between urban and rural areas and by obstacles to migratory flows.

Despite dissimilar patterns in the variation of their wages over the urbanization variable, adult male and female workers were alike in receiving higher rates of compensation in larger manufacturing establishments. The elasticity of the wage with respect to the number of employees in a firm is estimated to have been about 0.03 for both categories of workers. The coefficient for boy workers is of the same magnitude, but barely significant statistically. These estimates imply that there would have been no increase in relative wages had the size distribution of firms for each category of workers remained the same. A greater increase in the size of firms employing females than in the

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Notes and Sources: (Table 6, continued)

These regressions were estimated over those firms in the 1832 McLane Report sample which reported the necessary information in an apparently accurate fashion. Annual wages were computed from the daily or weekly wages reported by assuming 310 days or 52 weeks of work per year. The table presents the regression coefficients with t-statistics appearing in parentheses. The intercept represents the annual wages of the particular class of employees in a Middle Atlantic paper mill. Although it varied somewhat over regressions, the average firm was located in a county where roughly 30% of the population resided in urban areas. The equation for the adult male wage was estimated over all firms hiring at least one adult male; that for the female wage was run over firms employing at least one female; and that for the boy wage was run over firms hiring at least one boy.

size of those employing males could generate a relative advance in the former's wage. The estimated increase could not have been produced by such changes since our computations were based on the assumption that the average firm size within each industry applied equally to men, females, and boys. [31] Thus the use of a measure of size of firm also fails to support the view that the increase in relative wages was due to female (or boy) employees commanding higher compensatory (percentage-wise) payments than adult male employees.

Although the estimated relationships between wage rates and size of firm do not seem to account for the increase in the relative wages of females, they are consistent with the hypothesized existence of compensatory payments for all classes of labor. There are, however, alternative explanations for the rise in wage rates over firm size. Accepting the characterization of large-scale manufacturing establishments as employing many unskilled workers along with a group of highly skilled or supervisory workers, it might be argued that adult male supervisors earned wages that more than offset the lower wages of unskilled males. The female pattern might similarly be attributed to the variation in skill mix over firm size.[32] Another plausible explanation is that larger firms paid higher wages because such enterprises were more likely to exhaust local supplies and premia had to be offered to attract individuals from outlying areas.[33] Finally, since our wage figures are based on reports of daily or weekly rates, one might suppose that the finding of higher wages in larger firms was an artifact due to their operating more hours per day. An analysis of information contained in the McLane Report, however, indicates that the number of hours in operation daily was unrelated to firm size.[34]

A similar set of regressions on the 1850 data, appearing in Table 7, also tends to refute the notion that the rise in the relative wages of females can be explained by a deterioration of working or living conditions and the need to compensate employees for it. As in 1832, male wages were positively related

TABLE 7

Explaining (Monthly) Wage Variation by Manufacturing Firms: 1850

	Log (Male Wage)	Log (Female Wage)
Intercept	2.898	2.577
	(29.78)	(23.75)
Log (% of County Population Residing in Urban Area)	0.099	-0.011
	(6.56)	(-0.44)
Log (Number of Employees)	0.024	-0.011
	(2.66)	(-0.48)
New England Dummy	0.197	0.014
	(11.45)	(0.26)
Industry Dummies:		
Cotton	-0.104	-0.161
	(-0.44)	(-1.33)
Iron	0.344	-0.503
	(3.11)	(-1.76)
Tannery	0.178	
	(1.76)	
Shoes	0.107	-0.526
	(1.08)	(-5.93)
Household Goods	0.239	-0.220
	(2.35)	(-1.28)
Perishables	0.179	-0.226
	(1.70)	(-1.26)
Construction	0.164	-0.081
	(1.67)	(-0.21)
Hand Trades	0.212	-0.275
	(2.14)	(-0.95)
Miscellaneous	0.180	-0.133
	(1.86)	(-1.54)
R^2	0.123	0.214
Number of Firms	1410	246

. . .continued

to the degreeof urbanization in the vicinity of the firm, and female wages were not. Male wages in 1850 continued to increase with the size of firm, but female wages no longer did. The apparent implication is that increases in industry firm size over time would lead to a downward, rather than upward, movement in the relative wages of females. Given that both variables seem only to have affected male wages, it is unlikely that the increase in the relative wage of females over time can be attributed to a greater need to compensate them for a deterioration in working conditions and environment.

These regression results provide additional evidence for our hypothesis that early industrialization both enhanced the relative productivity of females and children and increased the demand for their labor relative to that of adult males. [35] Furthermore, the increase in the relative wage of females within the agricultural and traditional sectors commented on by Carey and others, tends to negate the view that the increase in manufacturing could be solely attributable to a pattern of compensatory payments. The increase in the relative wage in both sectors indicates a rapid and efficient adjustment in this labor

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Notes and Sources: (Table 7, continued)

The male wage regression was estimated over those firms employing at least one male and no females. By excluding those firms that employed females, we are also excluding many of the establishments that hired boys. Since adult males and boys were grouped together in the 1850 census, the wage rates for males reported by such firms do not accurately reflect those for adult males. The female wage regression was run over those firms employing both males and females. The intercept represents the wages paid by a woolen establishment (not significantly different in this regard from paper mills) located in the Middle Atlantic. The average firm was located in a county where 50% of the population lived in an urban area.

market, in response to a greater increase in the demand for female workers relative to that for adult males. Our evidence seems consistent with the notion that an expansion of the manufacturing sector, in combination with advances in production methods that raised the relative productivity of females in manufacturing, led to a bidding up of the relative return to female (and child) labor. In the context of a two-sector model, if the expansion of the manufacturing sector, relative to agriculture, is induced by shifts in demand, neutral technological, or adult male-saving technological change, the wage of its intensive factor (female labor) will rise relative to that of the intensive factor in agriculture (adult male labor).

IV

The early industrialization of the Northeast was accompanied not only by a rise in the relative wages of women and children, but also by increases in the rates of participation in the market economy of these two groups. These increases in labor participation render the advances in relative wages even more impressive, since the advances would have been even greater had the labor supply of women and children been as inelastic as was that for adult males. A precise estimation of changes in the labor participation of these groups cannot at present be made. Nevertheless, since few women and children worked in northeastern agriculture or household industry even during the pre-industrial period, their participation in the market economy must have increased substantially.[36] Contemporary observers linked increases in the labor force participation of women and children to the growth of the manufacturing sector. In his well-known Report on Manufactures, Alexander Hamilton argued that the growth of manufacturing would result in "the employment of persons who would otherwise be idle" and that "in general, women and children are rendered more useful, and the latter more early useful, by manufacturing

establishments than they would otherwise be."[37] Forty years later, manufacturers surveyed for the McLane Report appear to have shared the view that outside the manufacturing sector, "females . . .had little else to do" and "girls and boys have no other employment (Vol. II, p. 141)."

Wherever significant industrial development occurred, labor force participation rates for young women were quite high. In Tables 8 and 9 we present estimates of a "manufacturing labor force participation rate" for young females in five northeastern states and in the counties of Massachusetts. The figures express the number of females counted in the various surveys and censuses as employed in manufacturing as a percentage of the total female population 10 (or 15) to 29 years old in the particular state or county and are accordingly lower bounds to a true labor force participation rate. However, the greater the number of employed women over 30 years old, the less accurate is our proxy for this manufacturing participation rate. There is, though, abundant evidence that during the early period about 88% of women working in the large textile mills in Lowell were under 30 years old, and even in 1888, after manufacturing had become far more concentrated in urban areas, about 86% of all female industrial workers were under 30 years old.[38]

The data in Table 8 must be interpreted in light of the sévere undercounting of firms in the McLane Report, for all states but Massachusetts. Although figures for 1832 are uniformly lower than are those in later years, a correction for this under-enumeration would reduce these differences. In any event, the 1832 manufacturing participation rate estimates, ranging across states from 12% to 27%, indicate that the manufacturing sector was attracting a substantial portion of the population of young women in the Northeast. In the early-industrializing state of Massachusetts, for which reporting appears reasonably complete, one-third of all young females were employed in the manufacturing sector by 1850, if

TABLE 8

Females in Manufacturing Employment as a Percentage of 10 or 15 or 29 Year Olds in Five States: 1832 to 1880

	1832	1837	1850	1860	1870[c]	1880[c]
Connecticut	.116[a]		.226	.231	.184	.285
					[.191]	[.337]
Massachusetts	.271[a,b]	.402[b]	.329	.284	.367	.328
	[.187]	[.297]			[.440]	[.395]
New Hampshire	.116[a,b]		.201	.220	.217	.281
	[.105]				[.266]	[.336]
New York			.080	.068	.092	.153
					[.108]	[.187]
Rhode Island	.266[a]		.265	.333	.487	.409
	[.246]				[.539]	[.450]
% of Total Female Manufacturing Employment in Five States			.703	.629	.607	.565
					[.613]	[.577]

[a]The returns for Rhode Island listed women and children separately. The Massachusetts and New Hampshire estimates assume that 45% of all children were female and divide the total employment figure by those 10 to 29 years old. The bracketed figures give the employment of adult women as a percentage of those 15 to 29 years old. The Connecticut estimate is only for adult females and has been expressed as a percentage of females 15 to 29 years old. In all cases, the population figures for 1832 are for white females only and are from the 1830 Census of Population.

[b]The estimates include women in workshop employment, mainly palm leaf hats and straw hats, bonnets, and braids; the bracketed figures exclude them. See Table 9, Notes for Col. (1) and (2).

[c]Children were allocated between boys and girls as given by the 1880 population figures for children in manufacturing employment by states in the 1880 Census of Manufactures, V. 2, p. xxx. The bracketed figures express the number of females 15 to 29 years old employed in manufacturing as a percentage of those 15 to 29 years in the population.

Sources: Same as for Table 1, and Censuses of Population for 1830 through 1880.

TABLE 9

Manufacturing Employment of Females and Migration within and to Massachusetts: 1832 and 1837, and 1820 to 1840

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Female Manufacturing Workers as a Percentage of Females 10-29 Years Old				Net Migration of Females 10-19 Years		Net Migration of Females 20-29 Years	30-39 Years
					(Expressed as a % of Those 10-19 in later Year)		(Expressed as a % of Those 20-29 or 30-39 in Later Year)	
County	Firms 1832	Firms 1837	Firm and Workshop[a] 1832	Firm and Workshop[a] 1837	1820-30	1830-40	1830-40	1830-40
Essex	28.6	44.7	28.6	44.7	2.2	6.7	5.5	10.9
Middlesex	25.4	43.1	26.5	47.0	14.9	29.8	41.8	1.6
Bristol	22.3	25.9	34.0	34.3	10.6	9.7	11.4	-1.1
Worcester	21.1	28.7	42.1	49.7	2.0	2.6	8.3	-7.9
Norfolk	21.0	30.6	66.0	73.7	6.4	15.7	22.9	2.6
Suffolk	20.0	21.6	20.0	29.0	21.3	23.7	49.5	-1.2
Hampden	17.0	28.1	17.9	29.7	5.5	15.7	9.1	-8.4
Berkshire	12.0	16.6	12.0	16.6	-10.3	-2.0	-2.0	-15.6
Hampshire	11.7	11.0	28.6	33.4	1.2	-3.3	-13.4	-17.0
Plymouth	8.8	21.3	11.2	26.0	3.6	4.8	-11.3	-2.8
Franklin	4.1	4.9	11.6	15.1	-16.3	-13.3	-25.4	-14.7
Barnstable	2.4	1.7	2.4	1.7	0.5	-3.4	-6.6	-5.1
Dukes[b]	0	0	0	0	-1.2	2.9	12.5	-4.2
Nantucket[b]	0	0	0	0	-4.8	12.3	7.2	-2.6
Entire State	18.7	29.7	27.1	40.2	4.8	11.2	19.6	-3.5

[a]Workshop employment consisted almost entirely of the production of straw products and palm leaf hats by families in their homes.

[b]Because there were manufacturing firms in these counties in 1820, it is possible that there was an undercounting of such firms in 1832 and 1837.

Notes:

Col. (1) Manufacturing employment from McLane Report. Population of females 10 to 29 years old from 1830 Census of Population.

Col. (2) Manufacturing employment from 1837 . . . Industry in Massachusetts, pp. 169-200. Data for Suffolk County were added separately from the stated returns, because the summary tables divide employment by sex only for major industries. Female employment for printed cotton goods was derived by multiplying total employment by 0.75, the percentage of employees who were female in cotton textiles. Population of females 10 to 29 years old was derived for 1837 from the 1830 and 1840 Censuses of Population by assuming a constant rate of increase over those years.

Col. (3) and Col. (4) Workshop employment is defined as the number of "full-time" persons producing goods in the home for market sale. "Full-time" equivalents were derived for both 1832 and 1837 based on information in the McLane Report. Detailed information on palm leaf hat production in Worcester indicated that a woman working full-time produced 1.58 hats per day; each hat sold for 28¢ and each woman received 30¢ per day on average. Laborers, therefore, received 2/3's of gross earnings. If the dollar value of straw products and palm leaf hats equals V, the number of full time laborers, L, is given by:

$L = [\frac{V(2/3)}{90}]$, where \$90 was the full-time yearly earnings of a woman working 300 days per year.

The figures derived are comparable to, but somewhat less than, the full time female labor equivalents given by the enumerators in the McLane Report for several counties.

Col. (5) and Col. (6) These figures are the number of females who migrate to (or from) a county, on net, as a percentage of the number at the later year. Because of the wide age groupings given in the 1820 Census, this calculation could only be done for ages (0 to 9) in the early year, surviving to ages (10 to 19) in the later year. The procedure used was the forward survivorship method. The estimate of the percentage (0 to 90 years surviving to (10 to 19) years used is 0.93. This estimate is somewhat high considering that Massachusetts in 1828-30 had a life-table for women resembling a "West" Model level 11 or 13. See Maris Vinovskis, "Mortality Rates and Trends in Massachusetts before 1860," Journal of Economic History, XXXII (1972), 184-213. It is most probable that the number of very young children was consistently underestimated and, therefore, high survivor rates were used. If ρ = survivor rate, the table gives:

$$\left[\frac{(P^{1830}_{10\text{-}19}) - \rho(P^{1820}_{0\text{-}9})}{P^{1830}_{10\text{-}19}}\right]$$ where P^t_n is the population of age group n in year t.

Col. (7) and Col. (8) The same procedure is used as in Col. (5) and (6); ρ = 0.90 for (7) and .85 for (8).

Sources: 1832 McLane Report, 1820, 1830 and 1840 Censuses of Population; 1837 . . . Industry in Massachusetts.

not well before. This level roughly equalled that prevailing in 1880. In other states, as well, increases in the manufacturing labor force participation rate of young females continued after 1850, but had by that date already reached levels approaching those achieved twenty or thirty years later.

Recognizing that some young women were employed in alternative pursuits such as domestic service and teaching, the crude manufacturing labor force participation rates indicate that a high proportion of single women in New England had been drawn into the market economy by the 1830's. Comparable evidence on female labor force participation does not exist before 1832, but the levels implied by the 1830's data must have been achieved quite rapidly, since opportunities for the employment of females were limited prior to industrial development. This conjecture is supported by our estimates for the counties of Massachusetts in 1832 and 1837, presented in Table 9. In the more industrialized eastern counties (Essex, Middlesex, Bristol, Suffolk, and Norfolk), an extremely high percentage of young single women, at least equal to the statewide total prevailing near the end of the century, must have been employed in the manufacturing sector. The western counties more closely resembled a pre-industrial region having far lower manufacturing labor force participation rates for females.

It is unlikely that the contrast between these two sets of counties could be fully accounted for by employment of females in the agricultural and traditional sectors or by migration to and within Massachusetts from 1820 to 1830. The last four columns in Table 9 contain estimates of net migration rates, computed by the forward survivor method, of young women into Massachusetts counties over the periods 1820-30 and 1830-40. The wide age categories used in the 1820 Census of Population allow us only to calculate an 1820-30 migration rate for the 10-19 years age group. For the 1830-40 period, migration rates can be calculated for three different age groups of young women (where the migration rate is expressed as a percentage of the particular age group in the end year). Our estimates suggest

that, in general, counties with high manufacturing labor force participation rates appear to have experienced far greater in-migration by young women in the 1830 to 1840 period than from 1820 to 1830. The 1832 labor force participation figures therefore reflect the migration of females over short distances within counties, while the later figures indicate a migration across counties and to Massachusetts from other parts of New England, Canada, and Europe. This heightened movement of labor may explain why the coefficient on firm size in the 1850 wage regression (Table 7) differed from that for 1832 (Table 6); firms may have initially been faced with a fairly steep labor supply function which migration tended to lower.

Despite the continuing increase in the rate of participation by women in the manufacturing sector, the proportion of its labor force that they comprised seems to have peaked prior to 1850. The movement of females into this work-force was eventually outweighed by the shift of adult males from agriculture to manufacturing. Within the Northeast, we estimate the share (see Table 1) to have declined from roughly 32% in 1832 to 29% in 1850 (24% without clothiers), and to even lower levels later in the century. In Massachusetts, where state censuses of manufacturing provide better documentation, the decline was fairly abrupt, from 49% in 1837 (including workshop production) to 39% in 1850 (36% without clothiers and tailors).

The change in the proportion of the manufacturing labor force that was female can be decomposed into three parts: (1) the change in the female employment share of particular industries by size class, (2) the change in industrial composition by size class of firm, and (3) the change in the size distribution of firms across all industries. Of these three components two of them tended to decrease the female proportion of the manufacturing labor force. There was both a decline in the female employment share of particular industries, and a relative decline in industries most intensive in female labor. A general shift to larger firms within industries partially offset these two movements. A simple accounting of the sources of decline

in the female share of the manufacturing labor force from 1832 to 1850 indicates the following: [39]

	Change in the Female Share Due to Changes in:			
	(1) Female Share within Firms by Industry and Size	(2) Industrial Composition by Size Class	(3) Firm Size Across Industries	Total Change
1850 - 1832	-2.79	-8.98	+4.98	-6.80

The primary component appears to be industrial composition, although this factor would be reduced somewhat if we fully included the clothing establishments. The decline in the female share within industries by size class had a smaller effect and one which was overpowered by the general increase in average firm size within industries. [40]

V

Our principal findings are: (1) that women and children composed a large share (over 40% in 1832) of the entire manufacturing labor force during the initial period of industrialization in the U.S., but that this share began a secular decline as early as 1840; (2) that the wage of females (and boys) relative to that of adult males rose wherever large scale manufacturing establishments spread and that by 1850 this ratio had risen to almost 90% its long-term level; (3) that the labor force participation of young unmarried women in the industrial counties of the Northeast was, in 1832, high by late nineteenth century standards; and (4) that the employment of females and boys was closely associated with production processes used by large establishments. These features of the industrial work-force have not been completely overlooked, but their importance has been vastly underrated since the time of Hamilton and Gallatin.

The prominence of women and children across industries in large-scale establishments and the disproportionate concentration of these groups in such firms may help in understanding certain features of early industrialization and the factory system. They suggest that the factory system may have been important even outside the mechanized industries, because it enhanced the productivity of two previously under-utilized groups, who composed over one-third of the entire population. The low initial relative productivity of females and children in the pre-industrial Northeast, together with this region's relatively dense population, may have been major factors in its early lead among all regions in industrial development.

[1]The notion that abundant land provided an incentive for labor-saving technical change can be traced back to many early nineteenth century observers. The best known recent exposition of this argument is H.J. Habakkuk, American and British Technology in the Nineteenth Century: The Search for Labor Saving Inventions, (London, 1967), however see Richard Clarke and Laurence Summers, "The Labour Scarcity Controversy Reconsidered," Economic Journal, 90 (March 1980), 129-39, for a more formal modeling of the role of land availability in the process of industrialization. While the major emphasis has been on the use of capital to conserve on labor, Habakkuk recognized that females and children were also used (p. 65). Stanley Lebergott, Manpower in American Economic Growth: The American Record Since 1800 (New York, 1964) contains an astute discussion of the substitution of female and child for adult male labor and the workings of this early market in unskilled labor (pp. 125-29). The literature on the substitution of females and children for male labor in the British experience is extensive, see, for example, Ivy Pinchbeck Women Workers in the Industrial Revolution (London, 1930), and Peter Mathias The First Industrial Nation (London, 1969), Chapters 1 and 5.

[2]See Thomas Dublin, Women At Work: The Transformation of Work and Community in Lowell Massachusetts, 1826-1860 (New York, 1979) and Pamela J. Nickless, "Changing Labor Productivity and the Utilization of Native Women Workers in the American Cotton Textile Industry: 1825-1860," unpublished doctoral dissertation, Purdue University, 1976, among other recent additions to this literature. Edith Abbott, Women in Industry: A Study in American Economic History (New York, 1910) has coverage of most of the important industries, but with little systematic analysis of the pre-1850 period. The employment of women in the paper industry is discussed in Judith A. McGaw, "'A Good Place to Work.' Industrial Workers and Occupational Choice: The Case of Berkshire Women," Journal of Interdisciplinary History

X (Autumn 1979), 227-48. The cotton textile industry has also dominated the literature on the substitution of child and female labor in Britain, e.g. Clark Nardinelli, "Child Labor and the Factory Acts," Journal of Economic History, XL (Dec. 1980), 739-55.

[3]Claudia Goldin and Kenneth Sokoloff, "The Relative Productivity Hypothesis of Industrialization: The American Case, 1820-1850," National Bureau of Economic Research Working Paper No. 722, (1981).

[4]This conception of early industrialization seems consistent with that of Thomas Cochran, Frontiers of Change: Early Industrialism in America (New York, 1981) who writes: "An intermediate stage between the mechanized factory using water power and handwork done at home was the shop that brought together a large number of handworkers. Here there could be minute division of labor, hence a decreasing need for general skill, and constant supervision could ensure a more reliable volume of production (p. 57)."

[5]For example Lebergott, Manpower in American Economic Growth. . . used the wage data in the McLane Report (see footnote 6), and Alfred Chandler, The Visible Hand: The Managerial Revolution in American Business, (Cambridge, MA., 1977) used the data on large enterprises. On the 1850 sample see Fred Bateman and Thomas Weiss, A Deplorable Scarcity: The Failure of Industrialization in the Slave Economy (Chapel Hill, 1981).

[6]The official title of the McLane Report is the Documents Relative to the Statistics of Manufactures in the U.S., Vol. I and II, U.S. Congress, Serial Set Numbers 222 and 223, (Duff Green, 1833), named after the then Secretary of the Treasury, Louis McLane. Each of the three data sets has problems that complicate the analysis.

Among the most serious defects is that the quality of the coverage differed substantially by geographic region and that small manufacturing establishments are under-represented (in nearly all areas) in the 1820 and 1832 data. These sample selection biases prevent a straightforward calculation of aggregate totals, but allow the computation of averages for classes of manufacturing firms, and a re-weighting of them to arrive at manufacturing sector averages. Another of our concerns is that the categories of information on employees and their wages reported vary from census to census (or survey in the case of the McLane Report). In the 1820 census, adult males and females were enumerated apart from children, often separately listed as boys and girls. However only a total (annual) wage bill was given. The 1832 McLane Report generally listed adult males separately from boys less than seventeen years old, but grouped females of all ages together. Although coverage and detail varied considerably by state, wages in the McLane Report were typically given as a daily (or weekly) average wage for each class of employees. The 1850 census distinguished only between males of all ages and females of all ages, and wage data were reported as the average monthly wage for each group.

[7]The proportion of the labor force employed in the different sectors can be computed from information contained in the 1820, 1840, and 1850 Censuses of Population. The data indicate that the share of the labor force in agriculture was shrinking after 1820, if not before.

Proportion of the Labor Force Employed in Agriculture

	Middle Atlantic	New England
1820	.74	.73
1840	.65	.61
1850	.34	.33

Although the 1820 and 1840 censuses were designed to include men, women, and children in their labor force estimates, the 1850 data were explicitly confined to males over the age of fifteen.

[8]The data on employment by firm in the three major sources we have used is to be interpreted as average yearly employment. In 1820 the respondents of many firms clearly stated that this was their procedure. In 1832 New England employers were asked by the McLane Report to give the average annual number of employees. The 1850 Census of Manufactures asked for the average monthly employment.

[9]The 1820 and 1832 proportions of the manufacturing labor force composed of women and children were estimated by weighting the proportions for particular categories of firms, to adjust for potential biases. Our method uses the definition

$$P_f = \sum_j \sum_i S_j X_{ij} I_{ij} ,$$

where P_f is the aggregate proportion of the manufacturing labor force that is female, S_j is the percentage of the total manufacturing labor force employed in firms of size class j, X_{ij} is the percentage of the labor force in size class j working in industry i, and I_{ij} is the percentage of the labor force in firms of industry i and size class j that is female. The under-enumeration of small firms in both 1820 and 1832 is reflected in biased S_j's, and the disproportionate representation of New England firms in 1832 biases both the S_j's and X_{ij}'s. We have assumed that the observed I_{ij}'s are unbiased, but have varied the assumptions about the other weights.

The sample of firms from the 1820 Census of Manufactures was drawn from randomly selected counties. Since the omission of firms from the census was apparently a function of their size rather than industry, it seems reasonable to assume that the sample X_{ij}'s are unbiased, but that the S_j's are biased by the under-enumeration of small establishments. The Table 1 estimate uses a conservative assumption about the S_j distribution, that 40% of the labor force was in the small category (1 to

5 workers), 40% in the medium (6 to 15 workers), and 20% in the large category. Assuming an equal division of the labor force among size classes (33.3% in each) gives 10.6% of the manufacturing labor force composed of adult females and 25.0% composed of children. A very extreme assumption of 25%, 25%, and 50% in the respective classes yields 12.8% adult females and 27.4% children.

The sample drawn from the McLane Report over-represents firms from New England, particularly Massachusetts, and therefore it is likely that both the X_{ij}'s and the S_j's are biased. To check the sensitivity of our estimates, we have varied the assumptions about both distributions. The 1832 estimate in Table 1 is based on the sample X_{ij}'s and an assumption that 25%, 25%, and 50% of the labor force were employed in the respective size classes. An assumption of 33.3% in each class yields an estimate of 26.5% females and 8.5% boys; an assumption of 18%, 15%, and 68% (the distribution observed in the 1850 sample), yields 38.6% females and 8.3% boys. Changing the X_{ij}'s to those observed in 1850 and keeping the S_{ij}'s also at their 1850 levels, yields 26.5% females and 8.4% boys. Using 25%, 25%, and 50% for the S_j's, but taking the X_{ij}'s from 1850 yields 22.4% females and 8.6% boys. Since several of the highly female-intensive industries, such as textiles, were in relative decline by 1850, this latter estimate is substantially biased downward.

[10]See, for example, Arthur H. Cole, The American Wool Manufacture, 2 vols. (Cambridge, 1926); Blanche Hazard, The Organization of the Boot and Shoe Industry in Massachusetts Before 1875 (Cambridge, 1921); and Caroline F. Ware, The Early New England Cotton Manufacture: A Study in Industrial Beginnings (New York, 1931).

[11]As shown in Table 2, even Massachusetts, the textile center of the U.S., experienced a decline in the proportion of all employed females in manufacturing working in textiles, from 48% in 1837 to 36% in 1850.

[12]The problem of under-enumeration of small firms prevents us from calculating precise estimates, at the industry level, of the proportion of the labor force

composed of women and children. To illustrate that these classes of workers were prominent in many industries, we present the raw figures (unadjusted for sample selection bias) for selected industries:

	Percentage of Women and Children Among All Employees	
Industries, Northeast	1820	1832
Boots and Shoes	27.8%	46.2%
Domestic Goods (i.e., candles, soap)	22.2	28.6
Fine or Precision Goods (i.e., clocks, jewelry)	28.5	38.9
Glass	8.5	19.5
Hats	26.2	19.0
Iron Goods	12.0	18.7
Other Metal Goods	19.1	12.1
Paper	57.0	39.4
Tobacco (i.e., cigars, snuff)	66.5	83.5

[13]All three of these ways of saving on a scarce factor of production were discussed by Habakkuk in his American and British Technology. . . . The ensuing debate on his work, however, focused solely on the substitution of capital for labor, in spite of Habakkuk's clear acknowledgment of there having been several classes of labor, some of which were associated with the use of capital (see p. 65 in particular). For examples of the debate, see Peter Temin, "Labor Scarcity and the Problem of American Industrial Efficiency in the 1850's," Journal of Economic History, XXVI (Sept. 1966), 277-98, and Robert W. Fogel, "The Specification Problem in Economic History," Journal of Economic History, XXVII (Sept. 1967), 283-308.

[14]Regressions of the log (fixed capital/value added) across our 1832 firms indicate that only in textiles (wool and cotton) and paper was capital intensity significantly and positively related to the percentage of the labor force composed of women and children and to the total size of the labor force, (constructed as a weighted average of the three classes of labor). Across the entire sample of

firms both the labor force variable and that for the percentage women and children are significantly negative.

[15]Pearce Davis, The Development of the American Glass Industry, (Cambridge, MA. 1949), p. 48.

[16]Hazard, The Organization of the Boot and Shoe Industry. . ., pp. 85-6.

[17]Sex and age are not merely proxies for skill, they are also proxies for opportunity costs. For a more extensive discussion of this topic see Goldin and Sokoloff, "The Relative Productivity Hypothesis. . .," and for a caution about the use of sex as a proxy for skill see Pamela J. Nickless, "A New Look At Productivity in the New England Cotton Textile Industry, 1830-1860," Journal of Economic History, XXXIX (Dec. 1979), 889-910.

[18]While much of the literature on the role of the factory has stressed the importance of machines in accounting for the increase in the scale of firm from cottage industry, another segment has pointed to the role of discipline and supervision. Stephen Marglin, "What Do Bosses Do? The Origins and Functions of Hierarchy in Capitalist Production," The Review of Radical Political Economics, VI (Summer 1974), 33-60 is the best source on this point.

[19]For two recent, but different, views on the causes of industrial expansion and of regional variation in industrialization see Alexander Field, "Sectoral Shift in Antebellum Massachusetts: A Reconsideration," Explorations in Economic History, 15 (Apr. 1978), 146-71, and Robert Brooke Zevin, The Growth of Manufacturing in Early Nineteenth Century New England, (New York, 1975).

[20]We develop these ideas more formally in Goldin and Sokoloff, "The Relative Productivity Hypothesis. . ." which asks how exogenous differences between the agricultural sectors of two economies affect the pace and pattern of industrial development, with examples drawn from the histories of the U.S. North and South.

[21]The role of population density in the industrial development of New England is discussed in Ware, The Early New England Cotton Manufacture, p. 14.

[22]In his article on the Brandywine area of Delaware, which industrialized very early, Adams reports nearly identical relative wages for females to males for agriculture (domestic work) and manufacturing. See Donald Adams Jr., "Workers on the Brandywine: The Response to Early Industrialization," Working Papers from the Regional Economic History Research Center (1980) Vol. 3, No. 4. Ware, The Early New England Cotton Manufacture (p. 241) reviews the evidence on the increase in the wages of domestics during this period.

[23]Firms in the McLane Report generally listed wage rates separately for men, females, and boys. We have checked the information provided by some firms with alternative sources of data, and have concluded that the reported wage rates were averages, across skill classes, of the wage rates of all workers in the particular category (i.e., females). For example, we checked the wage rates reported by the Hamilton Manufacturing Company in Lowell, Massachusetts with the more extensive breakdown of female and male wages in that firm provided in Dublin, Women at Work..., p. 66. A number of firms explicitly indicated that their labor force figures were annual averages. Since enumerators appear to have recognized the issues involved and preferred annual averages, we suspect that most firms sought to provide yearly averages. The firms included in the 1820 census also appear to have generally sought to estimate and report the yearly averages of the labor force figures.

There is no question that the wage rates from the 1850 Census should be viewed as averages across skill classes for all workers in the particular category (males or females). Wage data were provided in the form of separate monthly wage bills for males and females. Firms in industries known to have employed many boys reported male wage rates (male wage bill/number of male employees) that were

discernibly lower. It is unclear whether the labor force figures from 1850 are yearly averages or simply a count of workers during the most recent month. In any event they do not involve the overcounting of workers with high annual turnover.

[24]Estimates of the wage of boys relative to that of adult males are not presented in Table 5, but are included in Goldin and Sokoloff, "The Relative Productivity Hypothesis. . ." Tables 1 and 2. These ratios increase from about 0.15 in agricultural New England in 1815 to from 0.41 to 0.45 in industrial New England in 1832. We cannot compute a comparable figure for 1850 because children were not listed as a separate category, see footnote 6.

[25]Our 1850 wage ratio (w_f/w_m) differs from that cited in Lebergott, Manpower in American Economic Growth. . . and used by Paul David in his work in technical change in cotton textiles, Paul David, Technical Choice, Innovation and Economic Growth: Essays on American and British Experience in the Nineteenth Century (London, 1975). The 1850 Census of Manufactures did not clearly state whether there was a lower age limit for the laborers included, and the 1880 Census of Manufactures, in a survey of trends, mistakenly claimed that the 1850 returns covered only adult laborers. In fact, the 1850 returns surveyed firms about all laborers, and thus the inclusion of boys in 1850 imparts a downward bias to the 1850 male wage when it is compared to the 1832 figure, for which boys are separated. Thus the Lebergott-David data indicate a marked erosion in (w_f/w_m) from 1832 to 1850 and a sharp decrease in the male money wage over the same period. In constructing our 1850 figure we have used only industries in which boys were a small percentage of the labor force, thus eliminating the problem of noncomparability of wages over time. This confusion over the meaning of the 1850 wage rates may

explain why Nickless, "A New Look at Productivity in the New England Cotton Textile Industry. . .," obtains different results from David by using skill classes rather than sex distinctions.

It should be noted as well that these wage ratios are lower than the ratio of the female wage to the adult male wage in the agricultural South. The southern ratio was approximately 0.58 in 1860. See Table 1, Goldin and Sokoloff, "The Relative Productivity Hypothesis. . ."

[26]The evidence on the ratio (w_f/w_m) in manufacturing from 1885 to 1960 is from Claudia Goldin, Economic Change and American Women, (forthcoming).

[27]Some firms in 1832 did report wage rates separately for adult females and girls. In such cases, we used only the adult female wage in the regressions. Our method of computing the wage ratios in 1832 and 1850 has introduced another downward bias. The calculations were based on the assumption that the average size of firms employing females was the same as that of firms employing adult males. Since wage rates were positively related to firm size, and females generally worked in larger establishments than men, the estimated male wage is biased upward relative to the female wage. Hence, the estimated wage ratio will be biased downward slightly.

[28]Albert Gallatin, "Free Trade Memorial," reprinted in F. W. Taussig (editor), State Papers and Speeches On The Tariff (Cambridge, 1892), p. 129.

[29]Henry C. Carey, Essay on the Rate of Wages: With an examination of the causes of the differences in the condition of the labouring populations throughout the world (Philadelphia, 1835), p. 26.

[30]The extent of urbanization in the local county was calculated as the fraction of the county population residing in cities with a population of 2500 or more. Since the poor environmental conditions thought to have affected many industrial

workers were often linked to urban areas, our variable should be a reasonable proxy. The size of the manufacturing firm (as measured by the number of workers) might also be expected to constitute a useful proxy for undesirable working conditions for which employees would require compensation. Early factories may have had higher levels of noise and dirt than did the small shops (or the farms) they replaced. These factories also appear to have been distinguished by a more regimented organization of work.

[31]There were some differences between increases in the size of firms employing males and those employing females during this period. But these differences do not materially affect our findings on increase in the relative wage of females.

[32]Yet another reason might be that larger firms had a more experienced and therefore a more skilled female workforce. The evidence on this conjecture is not entirely unambiguous though. Nickless, "Changing Labor Productivity. . ." (Chapter 2) reports Layer's Nashua Mill data for 1833-1840 which indicate some decline in turnover, but with no discernible differences between males and females. Dublin's data on mean years experience for females in the Hamilton Mills, Women at Work. . ., p. 190, rise from 1836 to 1850. Thus the increase in experience can account for that in the real wage for women, but the increase in the relative wage might not be explained by this factor alone. On the relationship between experience and earnings in industry see Claudia Goldin, "The Work and Wages of Single Women, 1870 to 1920," Journal of Economic History, XL (March 1980), 81-8.

[33]This explanation is well suited to the extremely large textile firms, whose sites were determined primarily by the availability of water power and often had to attract female employees from all over New England. It does not, however, seem appropriate for manufacturing firms in general. One would expect such a wage

premium effect to be most prominent among large firms in rural areas, but the inclusion of an interaction term between size of firm and urbanization fails to sustain this conjecture.

[34]Several hundred firms included in the McLane Report provided information on the average number of hours per day they operated. A series of regressions based on the data from these firms yielded no statistically significant relationship between firm size and number of hours in operation daily. That industrial homework occasionally involved a shorter work day is confirmed by the McLane Report correspondent from Rockingham, New Hampshire, who stated that such work "is attended to by women and children, the wives and daughters of farmers, in connexion [sic] with the other household duties (Vol. I, p. 623)." We have not been entirely successful in isolating these "putting out" establishments.

[35]It should be noted that an increase in the relative wage for females and children is not inconsistent with the finding of Jeffrey Williamson and Peter Lindert, American Inequality: A Macroeconomic History (New York, 1981), that the ratio of the unskilled to skilled male wage fell during the same period. The apparent contradiction is reconciled in their forthcoming work on Britain, British Inequality Since 1670, in which they differentiate between skilled artisans in industries such as textiles and shoes on the one hand, and skilled workers in the capital goods sector and the professional elite on the other.

[36]In most of the pre-industrial Northeast, women, and to a lesser extent children, seem to have worked only occasionally in the agricultural sector. See Percy W. Bidwell and John F. Falconer, History of Agriculture in the Northern United States (Washington D.C., 1925), especially p. 116 and p. 275, and our discussion in Goldin and Sokoloff, "The Relative Productivity Hypothesis. . ."

[37]Alexander Hamilton, Report on Manufactures (1791), reprinted in Taussig, editor, State Papers and Speeches. . ., p. 19.

[38]On the early period see Dublin, Women at Work. . ., p. 258, footnote 9, and for 1888 see Carroll Wright, Working Women in Large Cities; Fourth Annual Report of the Commissioner of Labor, 1888 (Washington D.C., 1889).

[39]The data underlying the calculation are from the two samples and differ in certain respects from the data in Table 1. Thus the total change here is from 31.3% in 1832 to 24.5% in 1850, rather than 32.4% in 1832 to 24.1% (without clothiers and tailors) in 1850. The 1850 sample appears to have omitted many of the clothiers and tailors. As in footnote 9, the female share

$$P_f = \sum_j \sum_i S_j X_{ij} I_{ij}$$

and the sources of change have been averaged over the six ways of factoring $P_f^{1850} - P_f^{1832}$. The possibility of further cross effects has not been considered.

[40]The decline in the female proportion of the manufacturing labor force has played a prominent role in the history of the cotton textile industry. See Dublin, Women At Work. . . and Ware, The Early New England Cotton Manufacture. . . both of whom stress immigration and technical change as causal factors.