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AGRICULTURAL SEASONALITY AND THE ORGANIZATION OF MANUFACTURING DURING EARLY INDUSTRIALIZATION: THE CONTRAST BETWEEN BRITAIN AND THE UNITED STATES

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ABSTRACT

The United States differed dramatically from Britain in the way manufacturing was organized during early industrialization. Even before widespread mechanization, American production was almost exclusively from centralized plants, whereas the British and other European economies were characterized by extensive cottage manufacture. This paper argues that this contrast was rooted in a salient disparity between the land-to-labor ratios of the two countries. Together with its later settlement, the relative abundance of land in the U.S. led its agricultural sector to be much less concentrated in grain than was British agriculture. Since the labor requirements of grain production were much more seasonal than were those of the other major agricultural products of the era (dairy products, livestock, wood, and cleared land), and agriculture was the dominant sector in both economies, there were more seasonal fluctuations in British labor markets than in the American. We argue that this difference in the extent of seasonality is crucial, because cottage manufacture had a relative advantage in the use of offpeak or part-time labor. Quantitative evidence and a general equilibrium model are employed to present the analysis, and subject it to tests of consistency with the empirical record.

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The cottage or putting-out mode of manufacturing has figured prominently in the histories of many pre- and early-industrial economies. Scholars from other disciplines study cottage industry as a way of life with special cultural and demographic consequences, but economists and economic historians, have typically focused on the narrower issue of how its productivity and prevalence compared to those of alternative forms of manufacturing organization such as the factory.[1] Their work has for the most part been concerned with the record of a single country, Britain, and sought to account for the changing balance of output over the early stages of industrialization between cottage manufacture, where goods for market were produced in the home with or without division of labor, and manufacture in centralized plants or factories.[2] One school of thought views the initial success of cottage manufacture as simply a temporary stage of technological superiority attributable to savings in labor, capital, or transactions costs relative to production in centralized plants. Over time, changes in technology, especially machinery, eroded the advantages of cottage work, and made the factory the dominant form of manufacturing organization.[3] A competing perspective suggests, however, that the factory may have triumphed over cottage production because it facilitated the exploitation of labor by employers -- without necessarily being technically more efficient.[4]

This controversy over the economic basis of cottage industry has enhanced our understanding of how the organization of early manufacturing could have been influenced by the costs of transporting labor and products, the possibilities for loss or waste of materials, the desire to standardize output, efforts to extract more work per unit of time from employees, and related issues.[5] Despite the importance of this contribution, however,

several deficiencies of the research in this area might be noted. First, there has been little serious attempt to subject hypotheses to tests of consistency with evidence. The paucity of systematic data may be responsible, but the lack of attention to the information provided by cross-country variation is puzzling. Second, economists have for the most part neglected the relevance of seasonality, which historians have recognized as characteristic of cottage or putting-out manufacturing.[6]

This paper begins to remedy these problems by contrasting Britain and the U.S. in their reliance on different forms of manufacturing organization during early industrialization. It has long been acknowledged that cottage manufacture, where workers labored at home as individuals or in family groups, continued to be common in Britain across a wide range of industries well into the nineteenth century. This manner of organizing production was, however, relatively rare in the U.S. and largely confined to a few labor-intensive industries, such as boots and shoes and palmleaf hats.[7] Instead, the overwhelming share of manufacturing output intended for sale in the latter economy came from single plants with centralized production, which operated as either manufactories (so-called non-mechanized factories) or factories. Under this mode of organization, workers routinely left home each day to labor together in a structure intended exclusively for that purpose.[8] This divergence in manufacturing organization between the first two countries to realize sustained economic growth was reflected both in different practices by industry, as well as in the longer overall persistence of putting-out in Britain over time.[9] Indeed, it is but little exaggeration to describe Britain and the U.S. as having pursued alternative technological paths from the pre-modern world of the solitary artisan to the modern world of mechanized factories, both with respect to the organization

of manufacturing and to the pattern of productivity growth over time across industries.[10] Why the two societies parted technological company in this way is a question of much import for our understanding of early economic growth, and is the focus of our study.

Although not intended to exclude the contributions of other factors, our paper highlights the explanatory significance of a salient discrepancy between factor endowments of the two countries -- the ratio of labor to land. Together with the later time of settlement of North America, the higher labor to land ratio in pre- and early-industrial Britain led its agricultural sector to be more concentrated in grain than was U.S. agriculture. Since the labor requirements of grain production were much more seasonal than were those of the other major agricultural products of the era (dairy products, livestock, wood, and cleared land), and agriculture was a major sector in both economies, British labor markets exhibited more seasonality than did the American. We argue that this difference in the extent of seasonality is crucial, because cottage manufacture had a relative advantage in the use of offpeak or seasonal labor.

Factories were able to increase productivity through division and intensification of labor as well as through greater investments in fixed capital, but these gains were partially dependent on continuity in operations. Their relative efficiency was accordingly reduced or reversed by interruptions in labor supply during harvests and other intervals of peak agricultural demand for workers. From this perspective, cottage or putting-out manufacture could survive in competition with the technically more efficient factories, because it was more conducive to the effective harnessing of an offpeak or part-time workforce whose opportunity cost was relatively low. Moreover, the greater seasonality of labor supply in pre-

industrial Britain led that economy to rely more on this form of manufacturing organization, as compared to the centralized plant, than did its counterpart across the Atlantic.

The essential logic of this analysis is conveyed formally below in a general equilibrium model of the choice between alternative manufacturing technologies. Our model is based on three goods (a manufactured output and two agricultural products), and two inputs (labor and land), and assumes that prices are endogenous. Two technologies are available for producing the manufactured output: a single plant technology which requires full-time workers and a putting-out technology which can operate with part-time or seasonal labor, but is technically less efficient (less output per manhour). Agricultural outputs utilize land and labor, with one of them (say, grains) characterized by strong seasonality in labor requirements, and the other (say, dairy or other non-grain products) having more flexible labor requirements (with less seasonality embodied in the technology). Finally, the demands for the manufactured good and the second agricultural output are assumed to be income elastic; the demand for grains is income as well as price inelastic. We show that in such a model an economy with a higher labor to land ratio (i.e., Britain) will have a lower per capita income, a larger share of its labor force devoted to grain production, and consequently a greater proportion of its total manufactured output produced with part-time or seasonal labor (i.e., cottage or putting-out manufacture) than its counterpart (i.e., the U.S.).

In addition to providing an explanation of cross-national differences, the framework also offers insight into the dynamics underlying the evolution of manufacturing organization and the secular decline in seasonality during the industrialization of a single economy. For example, the model indicates

how neutral technological progress across industries (or increase in per capita income), the relative advance of factory technology, and decreases in the cost of international trade, would all lead the share of manufacturing output produced in central plants to grow and the extent of seasonality in the economy at large to decline. That the technical change of the eighteenth and nineteenth centuries may have undercut cottage industry in Britain hardly seems surprising, but considering the potential significance of foreign trade is novel. It may also be quite relevant. The marked expansion of grain imports into Britain during the late eighteenth century appears to have roughly coincided with the onset of decline in cottage manufacture. We present our model, and develop these implications in Section II. In Section III, the consistency of our interpretation with the empirical record is discussed. Section IV contains our conclusions, with suggestions for future research.

II.

In order to highlight the effect of the factor endowment on the extent of cottage manufacture, we employ a simple model with three goods, grain, a composite of all non-grain agricultural products, and manufactures, which are produced by two factors, land and labor. Grain production requires both land and labor, and its production function has the standard neoclassical properties (constant returns to scale, continuous substitution of factors, and diminishing returns to each factor). Growing grain, however, only employs labor for part of the year, and workers in that sector have two alternative activities which they can engage in during the offseason, dairy and other non-grain agricultural production or cottage manufacture.

Manufactures can also be produced in factories, an organization of production which uses full-time year-round employees. Thus, there are three categories into which labor can be allocated:

L_1 factory workers

L_2 workers who produce both grain and other agricultural products

L_3 workers who produce grain and are employed in putting-out.

In the interest of simplicity, we assume that non-grain agricultural production, putting-out, and factory work are all activities which require only labor input. Hence, there are four distinct production functions:

$X_1 = a \cdot L_1$ factory manufacture

$X_2 = b \cdot L_2$ non-grain agricultural production

$X_3 = c \cdot L_3$ putting-out or cottage manufacture

$X_4 = f(T, L_2+L_3)$ grain production

where T is the fixed endowment of land, and a, b, and c are constants.

To consumers, manufactures produced through putting-out are indistinguishable from those produced in a factory, and it is convenient to choose this manufactured good as the numeraire. Let the relative price of grain in terms of manufactures be denoted as p, and the relative price of the non-grain agricultural products in terms of manufactures as p_N. We assume that a competitive labor market allocates a fixed labor endowment, L, among the three possible categories so that the marginal revenue product of labor is equalized across them. Making use of the fact that the marginal product of labor in factory production is simply a, these equilibrium conditions on the supply side can be expressed in the following equations:

(1) $$f_L(T, L_2+L_3) \cdot p + b \cdot p_N = a$$

(2) $$f_L(T, L_2+L_3) \cdot p + c = a$$

(3) $$L_1 + L_2 + L_3 = L$$

where f_L is the marginal product of labor in grain production. Equation (1) ensures that the return to being a full-time factory worker is the same as the return to growing grain plus producing dairy and other non-grain agricultural products in the offseason, whereas equation (2) is an analogous condition for those growing grain and devoting their offpeak period to putting-out.[11]

Equations (1) and (2) reveal that the relative price of the non-grain agricultural products in terms of manufactures is in fact fixed by the production coefficients in non-grain agricultural production and putting-out (as long as some labor is allocated to each of these activities). Since p_N must equal c/b, this price can be henceforth dropped as a separate variable.

Turning to the consumption side, we assume that preferences are such that the income elasticities of demand for manufactures and for non-grain agricultural products are the same, and greater than 1. This allows manufactures and non-grain products to be treated as a composite commodity that will be consumed in a fixed proportion, as long as the relative price between these two goods is unchanged at c/b. For convenience, choose units such that this fixed proportion in which the goods are consumed is equal to 1. While this framework is somewhat artificial, it enables the consumption side of the model to behave like a two-good model algebraically and facilitates the exposition. The production side fixes the price of non-grain agricultural produce relative to manufactures, and given the assumption about preferences, households consume equal amounts of the two goods at any

income level. There is really only one relative price free to vary, that of grain in terms of the non-grain/manufactures composite. Furthermore, the income elasticity of demand for grain must be less than 1, as that of the composite is greater than 1.

These assumptions permit three further equations to close the model:

(4) $$X_1 - X_2 + X_3 = 0$$

(5) $$f(T,L_2+L_3) - D(Y,p) = 0$$

(6) $$Y = X_1 + X_2 \cdot c/b + X_3 + X_4 \cdot p$$

where Y is aggregate income. Equation (4) ensures that total output of manufactures, from factories and putting-out, equals the output of non-grain agricultural products, so that if the market for one of these goods is in equilibrium, the other must be as well. Equation (5) stipulates that supply of grain equals demand for grain, with the latter a function of aggregate income and the relative price of grain. Hence (4) and (5), together with Walras' Law, ensure goods market equilibrium.

The system can be simplified by substituting for the X_is from the production functions and by using the definition of Y in equation (6). Equations (4) and (5) then become:

(4′) $$a \cdot L_1 - b \cdot L_2 + c \cdot L_3 = 0$$

(5′) $$f(T,L_2+L_3) - D(a \cdot L_1 + c \cdot L_2 + c \cdot L_3 + p \cdot f(T,L_2+L_3), p) = 0$$

The four equations (2), (3), (4′), and (5′) determine four variables, L_1, L_2, L_3, and p. Given the allocations of labor among the three activities, outputs can then be recovered from the production functions. For parameters that yield an interior solution (i.e. all L_i are positive), the equilibrium will be unique and stable.

This can be seen intuitively by considering the market for grain. If p is disturbed upwards from an equilibrium value, labor will be drawn into grain production and the supply of grain must rise. On the demand side, an increase in p must reduce demand.[12] Consequently, an increase in p from an equilibrium level creates excess supply of grain, and the equilibrium is stable.

The effects of an increased endowment of land, holding other parameters constant, on the prevalence of cottage manufacture and other endogenous variables can be examined by differentiating the system composed of equations (2), (3), (4′), and (5′) around an initial equilibrium. This yields the following matrix equation:

$$(7)\qquad \begin{bmatrix} 0 & f_{LL}\cdot P & f_{LL}\cdot P & f_L \\ 1 & 1 & 1 & 0 \\ a & -b & c & 0 \\ 0 & f_L & f_L & -h \end{bmatrix} \begin{bmatrix} dL_1 \\ dL_2 \\ dL_3 \\ dP \end{bmatrix} = \begin{bmatrix} -f_{LT}\cdot p\cdot dT \\ 0 \\ 0 \\ (D_y\cdot p - 1)\cdot f_T\cdot dT \end{bmatrix}$$

where subscripts denote partial derivatives and h is the Hicksian compensated change in demand for grain in response to an increase in own price, and is consequently negative. In deriving (7), we have made use of the Slutsky decomposition, $D_p = -D\cdot D_Y + h$, as well as the assumption that the demand for grain equals supply. The determinant of the matrix on the left-hand side of equation (7) is:

$$(8)\qquad (b+c)S = (b+c)[f_L^2 + H\cdot f_{LL}\cdot p] > 0$$

which is positive as f_L is clearly positive and h and f_{LL} are both negative. The changes in labor allocations and the price of grain in response to an increase in the endowment of land can then be solved for via Cramer's Rule:

$$(9) \qquad dL_1/dT = [f_T \cdot f_L(1-D_Y \cdot p) + f_{LT} \cdot h \cdot p]/S$$

$$(10) \qquad dL_2/dT = (a-c)[f_T \cdot f_L(1-D_Y \cdot p) + f_{LT} \cdot h \cdot p]/(b+c)S$$

$$(11) \qquad dL_3/dT = -(a+b)[f_T \cdot f_L(1-D_Y \cdot p) + (f_{LT} \cdot h \cdot p)]/(b+c)S$$

$$(12) \qquad dp/dT = -p \cdot [f_L \cdot f_{LT} - f_T \cdot f_{LL} \cdot (1-D_Y \cdot p)]/S$$

A sufficient condition for the relative price of grain to fall in response to an increase in the endowment of land is that $(1-D_Y \cdot p)$ be positive. The increased quantity of land increases aggregate income. The term $D_Y \cdot p$ is the marginal propensity to consume grain out of additional income (denominated in grain), so that $(1-D_Y \cdot p)$ is positive unless *all additional income* is expended on grain. With an income elasticity of grain below 1, the term is clearly positive.

What happens to the allocation of labor is more ambiguous. Within the brackets on the right-hand side of equation (9), which indicates the change in factory labor, L_1, the first term is positive and the second negative. This implies that holding p constant, an increase in the supply of land will draw labor out of grain and into factory production. Equation (9) indicates that the change in L_1, or in the prevalence of factory labor, is more likely to be positive as the absolute values of h and $D_Y \cdot p$ decline. That is, factory labor will increase with the land endowment when there is little substitution between grain and the non-grain/manufactures composite on the consumption side, and/or the marginal propensity to consume grain out of additional income is low. Intuitively, if the income and price elasticities are both low, then a larger endowment of land will increase aggregate income and lower the relative price of grain, but result in only a minor increase in the demand for grain. With the greater supply of land boosting grain output, labor is released from this sector, and shifts to

factory production.

Given that the bulk of the evidence on underdeveloped economies suggests that both the price and income elasticities for grain are inelastic, let us assume then that the conditions concerning the elasticities are satisfied, and that the labor force in factory production increases.[13] Inspection of equations (10) and (11) reveals that the labor devoted to dairy/non-grain production, L_2, will then increase as well, whereas labor devoted to putting-out production, L_3, will decline. Intuitively, the labor force in grain production declines, and furthermore, a greater proportion of this rural group will now engage in non-grain agricultural production to meet the increased demand generated by the growth in income. For both of these reasons, the labor devoted to grain-cum-putting-out decreases. This result also suggests that there is a level of land endowment when it is no longer economical to engage in putting-out -- at which point, this activity ceases. It also suggests that the ratio of the harvest wage to the off peak wage declines with the ratio of labor to land, in line with the shift of labor out of grain production.

The story that emerges from this model is that in a relatively land-poor, or labor-abundant, pre-industrial country, such as Britain, much of the labor force must be involved in grain production; consequently it is economical in such societies for some of these workers to be employed in putting-out manufacturing during the offpeak periods. In a land-rich, or labor-scarce, society, such as the U.S., on the other hand, a larger share of the labor force is released from grain production and available for full-time work in factory production of manufactures. The remaining labor force tends to specialize in non-grain agricultural production during the offseason.

In this way, the relative endowment of labor to land influences the path of industrial development.

The same model can be used to explore the effects on the prevalence of putting-out of general technological advance, occurring at the same rate in all sectors. For this comparative statics exercise, premultiply each production function by a technical parameter, t, which we can assume is 1 initially. When we differentiate the new system, allowing the endogenous variables and t to change, the result will be as in equation (7), except that the right-hand side will now be:

$$(13) \qquad \begin{bmatrix} 0 \\ 0 \\ 0 \\ -D \cdot (1-e) \cdot dt \end{bmatrix}$$

where $e = D_Y \cdot Y/D$ is the income elasticity of demand for grain. It is clear that across-the-board technical change will have no effect on the allocation of labor and the price of grain if demand is homothetic (i.e., income elasticities are 1 for all goods). In that case, the only change in the equilibrium is that proportionally more of all goods are produced, and these outputs will clear the goods markets at the original relative prices as long as demand is homothetic.

If we maintain the assumption that the income elasticity of demand for grain is less than 1, however, than $(1-e)$ is positive, and the endogenous variables change in the following way:

$$(14) \qquad dL_1/dt = D \cdot (1-e) \cdot f_L/S > 0$$

$$(15) \qquad dL_2/dt = (a-c) \cdot D \cdot (1-e) \cdot f_L/(b+c) \cdot S > 0$$

$$(16) \qquad dL_3/dt = -(a+b) \cdot D \cdot (1-e) \cdot f_L/(b+c) \cdot S < 0$$

(17) $$dp/dt = D \cdot (1-e) \cdot f_{LL} \cdot p/S < 0$$

With an income elasticity of demand for grain less than 1, the price of grain will have to fall as a result of technological advance. Labor will shift out of grain production and into factory work. Employment in non-grain agricultural production will rise, while falling in cottage manufacture. Intuitively, the technical advance increases aggregate income, a disproportionate amount of which is expended on other (non-grain) agricultural products and manufactures because of the higher income elasticity of demand for these goods. To accomplish this change in relative outputs, labor must shift from grain production into factory employment. The labor that remains in agriculture, in its offseason, will focus increasingly on dairy and other non-grain agricultural products. Putting-out declines for two reasons: a shift of labor out of agriculture into full-time industrial work, and, within the rural sector, a shift in offpeak labor from cottage manufacture to the production of non-grain agricultural commodities. It is also evident that an unbalanced achievement of technical change, which raised factory productivity relative to that of cottage manufacture, would have an even stronger dampening effect on putting-out production.

In summary, the model has several features or implications that can be checked for consistency with the experiences of Britain and the U.S. One test of our framework is that wage rates should vary more from the seasonal peak associated with grain harvests to the levels prevailing the rest of the year in the country (Britain) with the relative scarcity of land.[14] Along with evidence of greater seasonality in labor markets, we should also observe that cottage or putting-out manufacture was strongly associated with part-time or seasonal operations, and that this form of organization had

lower measured productivity, if not technical efficiency. Moreover, our analysis suggests that the share of the labor force employed in putting-out and the price ratio of grain to manufactures should be higher in Britain. A final implication of the model is that within both economies, general technical advance during early industrialization will be accompanied by a reduction in the share of the labor force engaged in cottage manufacture.

III.

The evaluation of the consistency of the model with the empirical record must begin with the issues of whether Britain did indeed have more seasonality in labor markets and cottage manufacture. These questions are not easily resolved, as the study of the pre- and early-industrial British economy is hampered by the limited amount of systematic evidence available. Indeed, so scattered is the direct information on agricultural seasonality and manufacturing activity that a recent book used parish records on the distribution of marriages over the year as a proxy for regional patterns.[15] It is clear, however, that enormous seasonal variation in the demand for labor in agriculture was a pervasive element of that economy, with the peak established by the harvesting of grain during a few months in late summer or early fall. Other activities for labor were spread out more evenly over the year with some, like the raising of livestock, actually having a mild increase in requirements during the late winter. Since grains easily composed the largest share of agricultural output, however, and had such a pronounced spike in labor requirements, the size of the agricultural workforce swelled significantly during August and September. Kussmaul finds regional differences in the seasonality of marriage that correspond to these fluctuations in the demand for labor. Districts that were relatively

specialized in grain avoided marriages in the harvest months, pastoral areas did so in lambing months, and industrial parishes had markedly less seasonality in marriages.[16]

Although no quantitative record has yet been assembled, scholars concur that cottage manufacture emerged as a major activity in England by the end of the seventeenth century, at a time when agricultural productivity and incomes were rising, and flourished over a broad range of industries well into the nineteenth century. The issue of whether there was much if any full-time cottage work has not been framed explicitly, but seasonality is conspicuous in most treatments of the practice.[17] Moreover, there is a vast literature detailing how agricultural workers frequently turned to manufacturing in their homes during the offseason. Part-time labor by women and children is also emphasized. This cottage or putting-out organization of manufacturing was quite competitive, coexisting with centralized plants in many industries and the dominant form in some. The beginning of its decline has not been precisely dated, and varied across industries, but the system was certainly under serious pressure by the early 1800s when the growth of both productivity and world trade accelerated, and grain production had declined in relative importance.[18] Cottage manufacture had become a way of life for a substantial segment of the rural population, however, and adjusting to the increasingly unfavorable environment was painful and protracted. Attachment to tradition is illustrated by the perseverance of significant numbers of old handloom weavers until the middle of the nineteenth century despite steep declines in their earnings and the exodus of their children to other endeavors.[19] In some of the more labor-intensive industries, cottage production hung on into the second half of the century.

Although the seasonal variation in labor requirements by agricultural output was of course very similar in the U.S. and Britain, the aggregate patterns differed significantly because of a major contrast in the composition of the respective agricultural sectors. Hard aggregate data are scarce for pre-industrial economies like these, but it seems clear that the highly seasonal grains accounted for a much smaller share of agricultural output in the U.S. than in Britain. For example, as the estimates in Table 1 indicate, the proportion of gross agricultural output composed of livestock and other animal products was nearly twice as high in the U.S. during the late eighteenth and early nineteenth centuries.[20] The implied gap in the relative importance of grains would be widened if one could distinguish between the other commodities, and control for the greater quantitive significance of wood, cotton, tobacco, cleared land and other non-grain and non-animal agricultural products in the new world economy. Since these other outputs were substantially less seasonal than grains, it seems reasonable that the agricultural labor force would have been more stable over the year in the U.S.. In the American Northeast, where industrial development was initially concentrated, farmers appear to have been fully occupied with dairying, woodchopping, and other tasks around the farm during the winter months.[21]

Perhaps the most direct method of obtaining a summary measure of the extent of the difference in the seasonality of labor markets between early-industrial Britain and the U.S. is to compare the movement of wages over the year. Estimates of the harvest to winter wage ratio could be computed for various counties in England and Massachusetts and are presented in Table 2. As is clear, wages were significantly higher during the months of harvest than during the winter even in Massachusetts, but the magnitude of the

TABLE 1

Shares of Livestock and Animal Products

in Gross Agricultural Output

	England and Wales	United States
1770	0.27	
1800		0.58
1820		0.58
1840		0.62
1846	0.33	
1860		0.48
1870		0.55

Notes and Sources: The estimates for England and Wales have been computed from the commodity output estimates prepared by Arthur Young for 1770 in his The Farmer's Tour Through the East of England, and by McCulloch for 1846. Both are reported in A.H. John, "Statistical Appendix," in G.E. Mingay, ed., Agrarian History of England and Wales, Vol. 6, 1750-1850, (Cambridge, 1989), Tables III.2(a) and III.2(b). The U.S. estimates have been computed from the data presented in U.S. Bureau of the Census, Historical Statistics of the United States, Colonial Times to 1970 (Washington, D.C., 1975), Series K 240-250. The later figures are thought to be more reliable.

TABLE 2

Ratios of Harvest to Winter Wages in
English and Massachusetts Agriculture, 1768-1852

	Harvest Wage / Winter Wage		Unweighted Average
England			
Counties Specialized in Grain			2.20
Cambridgeshire	2.00	(1804)	
Essex	2.00	(1805)	
Hertfordshire	2.00	(1768-71)	
Suffolk	2.13	(1793)	
	2.80	(1803)	
Surrey	2.25	(1768-71)	
Other Counties			1.73
Cheshire	1.60	(1794)	
Kent	1.67	(1768-71)	
Lincolnshire	1.50	(1768-71)	
	2.00	(1799)	
Northumberland	1.83	(1768-71)	
	2.00	(1768-71)	
	1.50	(1794)	
Northamptonshire	1.27	(1768-71)	
Sussex	1.29	(1768-71)	
	1.83	(1768-71)	
	1.68	(1793)	
Wiltshire	2.00	(1768-71)	
Yorkshire, West Riding	1.29	(1768-71)	
	1.67	(1768-71)	
	1.50	(1768-71)	
Yorkshire, North Riding	3.00	(1768-71)	
Massachusetts			1.42
	1.87	(1795-99)	
	1.60	(1800-04)	
	1.38	(1805-09)	
	1.54	(1810-14)	
	1.36	(1815-19)	
	1.25	(1820-24)	
	1.39	(1825-29)	
	1.77	(1830-34)	
	1.21	(1835-39)	
	1.62	(1840-44)	
	1.39	(1845-52)	

Notes and Sources: These estimates represent the ratio of the agricultural wage during the months of the grain harvest to that of the wage during the winter months. The English wage data are reported in just those categories in A. H. John, "Statistical Appendix", in G.E. Mingay, ed., Agrarian History of England and Wales, Vol. 6, 1750-1850 (Cambridge, 1989), Table IV.4 and IV.5. The estimates for Massachusetts were computed from data provided by Winifred B. Rothenberg. See her "Structural Change in the Farm Labor Force: Contract Labor in Massachusetts Agriculture, 1750-1855", in Claudia Goldin and Hugh Rockoff, eds., Strategic Factors in Nineteenth Century American Economic History: A Volume to Honor Robert W. Fogel (Chicago, 1991).

seasonal fluctuation was greater in the English case. Moreover, wages varied most between seasons in those English counties which were relatively specialized in grain, as judged by an unusually low ratio of livestock to acres of arable. These findings are consistent with the implications of our model that the supply of seasonal labor during offpeak periods at relatively low wages was related to the cultivation of grain, and more characteristic of the early stages of industrialization in England than in the U.S.. That is, since offpeak labor was relatively abundant in the former economy, one would expect that the organization of manufacturing better suited to its use would be more prevalent there.

Thus far, the application of our model to the study of the organization of manufacturing in pre- and early-industrial Britain and the U.S. is supported by the broad contours of development in those economies. First, agricultural products are reasonably divided into two groups: grains, which are strongly seasonal in their labor requirements; and the remaining outputs, such as dairy and other animal products, which are either less seasonal or complementary to grain production in their employment of labor. Since agriculture in the American Northeast was much less specialized in grains than in Britain, wages varied less over the year in the former. Finally, although our model compares two closed economies in which transportation costs prevented trade, the analysis can be extended to the eighteenth and nineteenth centuries when such costs were not prohibitive but did serve to maintain a significant wedge between output prices in the two economies. Indeed, the persistently higher relative price of grain to manufactures and the greater share of agricultural output devoted to grains in England are fully consistent with our framework.[22]

The specification of the manufacturing technologies is perhaps the most controversial feature of our model. In particular, the assumption that factories only employ labor on a full-time, year-round, basis is both stronger than the historical record warrants and than is necessary for the theoretical result. Recent work by Engerman and Goldin and Postel-Vinay on the U.S. and France respectively has suggested that there was at least some seasonality in factory as well as cottage manufacture.[23] In the latter country, for example, it was evidently routine for many workers to leave Paris for the countryside during the late summer months when grain was harvested.[24] Although our model abstracts from the possibility that both forms of organization could operate seasonally, the same qualitative finding could be derived in the more general framework as long as factories were less well suited to, or suffered a greater decrease in productivity from, part-time or seasonal operations.

Before turning to the evidence, there are several reasons why one might expect factories or central plants to have been more adversely affected than cottage producers by less than full-time production. One is that the factory was more intensive in fixed capital than the putting-out or cottage mode of organization -- even in the highly labor-intensive industries which quantitatively dominated the manufacturing sector during this period.[25] Since interruptions in production entailed idling such capital, they should detract more from the productivity of factories. Another important feature, however, is the greater work intensity and division of labor which came to characterize even non-mechanized factories during early industrialization. These changes in the organization of labor appear to have been a significant source of increase in measured productivity, and were generally associated with the use of more monitoring and teamwork.[26] Extremely difficult to

realize in cottage production, where workers were relatively isolated from both supervision and co-workers, these potential gains in productivity were also likely eroded by labor turnover or any breaks in routine which disrupted the familiarity of workers with the process. Such considerations suggest that the productivity of factories was more adversely affected by seasonal or other fluctuations in operations than was that of cottage production.

As noted above, a systematic body of information about manufacturing establishments during early British industrialization is not yet available. Hence, the scattered but repeated accounts of an association between cottage production and the use of part-time or seasonal labor in that economy might not in themselves persuade the skeptic. Fortunately, new evidence on this issue can be drawn from the U.S. experience. Cottage manufacture was rather uncommon in that country, and was largely confined to a few industries which relied extensively on female labor such as lace, palmleaf hats, and boots and shoes. Perhaps for this reason, the reports on a number of putting-out enterprises in an 1832 Department of Treasury Survey of manufacturers have received little attention.[27] The enumerators were especially diligent in Massachusetts, where they not only compiled a virtual census of conventional centralized plants, but also reported on the operations of firms which utilized cottage workers for much of their output. These data provide a solid empirical basis for evaluating the claim that the putting-out or cottage form of manufacturing organization was more conducive to seasonal or part-time production than the factory.

Nearly all of the factories or centralized plants included in this cross-section of firms operated on a year-round full-time schedule. Sawmills and iron mills make up most of the few which did not, and they

generally explained their seasonal shutdowns as due to the freezing of rivers during wintertime. In contrast, it is evident from the returns for cottage or putting-out enterprises that the men, women, and children engaged in such industry worked primarily on a seasonal or part-time basis. There are many reasons, ranging from cultural to the narrowly economic, why women and children would have preferred part-time employment, and thus it is not at all surprising that they appear disproportionately represented among cottage workers. Male employees, however, seem to have been on break during offpeak periods from farming or fishing. Among the discussions filed by enumerators are:

> a considerable number of persons who follow farming and the fishing business in the summer season, make shoes occasionally in the winter ... and this is the practice, more or less, in every town in the county.
>
> (for York and Kittery, ME)

> Many citizens of this town go to sea or fishing in the summer, and make shoes in the winter ... This town was almost entirely destitute of manufactories of any kind, except those immediately connected with their staple, the fisheries. Competition in the foreign fish market has materially changed the business of the town, and even the remaining fishermen now depend chiefly on the home market.
>
> (for Marblehead, MA)

> Besides the above named tobacco manufactories, many cigars are made in families, which probably gives employment to twenty females, and as many small boys.
>
> (for Saugus, MA)

> There are brought annually to three traders in this town, by the females in this and adjoining towns, fifty thousand palm leaf hats, which manufacture, like that of covered buttons, has sprung up within about six years ... the hats are made in private families; the coarser kind by quite small children. It is impossible to estimate with perfect accuracy, the extent of this manufacture.
>
> (for Northampton, MA)

> Manufacture of lasting and silk twist buttons is entirely carried on in private families by females who are paid by the groce. Materials are furnished, and contracts made with some hundreds of females residing in several adjoining towns by one person ... a great deal of this labor is performed in vacant time, when they have nothing else to do; which connected with the circumstance of the operatives being so scattered, renders it difficult to obtain an accurate estimate of this business in the respective towns, and to aportion the time and wages by the day.[28]
>
> (for Middlefield, MA)

These observations of enumerators appear entirely consistent with the quantitative information on production and wage compensation provided by the manufacturers of boots and shoes, encompassing both types of organization. Although analysis is complicated by the failure to precisely distinguish the putting-out firms from the factories, as well as the common practice among the former of having some workers in a central shop who were responsible for parts of the production process, and others at home for the remaining tasks, our method of classifying them (based on location and investment in fixed capital) yields a striking contrast in the implied extent of seasonality between the two sets of firms.[29] As indicated in Table 3, workers in centralized plants earned substantially more over the course of the year from manufacturing (and were more likely to be adult males) than did (were) their counterparts in cottage work. These estimates almost certainly understate the differences, yet adult males and females received over 25 and 100 percent more respectively on an annual basis from the former class of firms than from the latter.[30] These gaps, which are mirrored by a corresponding disparity in measured labor productivity, suggest a major difference between the forms of organization in the number of hours per year that the average worker devoted to manufacturing production. Other systems for categorizing firms, based on information about the quality of the shoes manufactured, lead to the same conclusion.

These discrepancies in earnings are large by any standard, but they cannot reliably be decomposed between those due to differences in the number of hours worked per year and those due to deviations in productivity per unit of actual labor-time.[31] Although the much larger disparity in compensation for women seems to confirm that the principal distinguishing factor between the two regimes is variation in hours worked per year, one might also view the result as partially accounted for by the greater sensitivity of female and child labor intensity to the organization of work.[32]

TABLE 3

Descriptive Statistics On Massachusetts Manufacturers

Of Boot and Shoes: Firm Averages

Centralized Production vs. Putting-Out, 1832

	Centralized Plants	Putting-Out Enterprises
Average Annual Male Earnings	$258.0	$203.3
Average Annual Female Earnings	$118.9	$ 55.6
Value Added/Equivalent Workers	$302.0	$220.5
% of Labor Force Which Are Women or Children	31.3%	59.6%
Number of Observations	24	84

Notes and Sources: The estimates of weighted averages are based on the information provided by shoemaking firms enumerated for Massachusetts in the 1832 Department of Treasury Survey of Manufactures, generally referred to as the McLane Report. U.S. House of Representatives, Documents Relative to the Statistics of Manufactures in the U.S., 2 vols., Serial Set Numbers 222 and 223 (Washington, DC, 1833). The wage figures have been annualized on a 310-day basis from the information reported on average daily compensation. The number of equivalent workers was computed as (number of adult males + (0.45 × number of female and child employees)).

Direct evidence on technical efficiency is not easily extracted from these data, but if labor and product markets were competitive, centralized production must have been more productive than cottage manufacture.[33] This follows because centralized shoemaking plants, which held their wage or piece rates constant over the year, survived in competition with enterprises which operated during offpeak periods -and could hire workers at lower wages. Since the average annual earnings from all activities to workers involved seasonally or part-time in cottage manufacture had to be roughly equal to those for full-time manufacturing employees (otherwise there would be flows of labor until they were equalized), and wages were lower during offpeak periods, cottage workers had to be receiving less compensation per unit of time in manufacturing than were those employed by establishments operating full-time throughout the year. For factories to have competed successfully while paying higher wages, their workers must have been producing more output per unit of time than did those in putting-out.[34]

To summarize, with this indirect support for the superior technical efficiency of the factory, the core structure of the model has passed a basic test of consistency with the available evidence. Not only were British labor markets more seasonal than were those of the U.S., as judged by the movement of wages over the year, but cottage industry was more closely associated with seasonal or part-time operations than were centralized plants. By the logic of our framework, therefore, it is not surprising that this form of manufacturing organization was much more characteristic of early industrialization in Britain than in the U.S.

The argument that offpeak or part-time labor with a low opportunity cost was the basis for the persistence of cottage industry is intriguing in

its simplicity, but several caveats should be offered. The first concerns the distinction between technical efficiency and cost efficiency. Although the two are often equivalent, they diverge here because of the advantage of cottage industry in making effective use of an irregular and cheap labor supply. Factories were generally more efficient in the technical sense of getting more output per unit of input, but putting out could at times be equally or more cost efficient because of its suitability for low-cost inputs. A second point is that the relative advantages of putting out and factory production of course varied across industries. For example, in highly labor-intensive industries like clothing or boots and shoes, cottage work remained competitive with centralized plants for a much longer period than did capital-intensive counterparts like textiles. A detailed history of the rise of the factory would require a comprehensive examination of technology in each industry, for this factor surely accounts for much of the variation in experience across industries.[35] A final issue is that the development of agriculture also deserves closer scrutiny. Differences or changes in technology, as well as those in product mix emphasized by the model, likely influenced the magnitude of seasonal fluctuations in labor markets over time and across economies, and thus help explain where and when cottage manufacture flourished.[36]

Although perhaps a weaker test of our framework, the comparative static results are consistent with the development of Britain and the U.S. Labor-rich and land-scarce Britain had its agricultural output more concentrated in grain, experienced greater seasonal fluctuations in wages, and relied more on cottage manufactures than did the American economy in cross-section. The other implication of the comparative statics is that neutral technical change would induce a decline in the share of manufactures produced by

putting out; progress in favor of manufacturing relative to agriculture, or of factories especially, would spur an even faster decline. Uncertainty about the precise timing and course of the decline in British cottage manufacture makes it difficult to apply strong empirical checks here. Nevertheless, the mechanisms in the model that highlight the significance of the diminishing share of the labor force in grains, whether through neutral technical change or some other source, seem to capture what was going on in the late eighteenth century. By most accounts, the prevalence of cottage industry peaked between 1750 and 1800, before widespread mechanization gave a substantial boost to the relative productivity of factories, and while broad but slow increases in productivity were fueling a shift toward manufactures and a more diverse diet.[37] The further coincidence of decreasing costs in ocean transportation and growing grain imports from abroad with the ebbing of cottage industry during the late eighteenth and early nineteenth century is also consistent with the model.[38]

IV.

This paper offers a broad perspective on the role of cottage manufactures in economic development, as well as provides a framework for understanding the evolution of manufacturing organization in Britain and the U.S. during their early stages of industrialization. It suggests that the salient contribution of that system was in improving the utilization of labor by expanding opportunities for production during the offpeak periods of predominantly agricultural economies or during various intervals of slack time in which individuals would be otherwise idled from their principal work activities. In a pre-industrial economy with an emphasis on seasonal crops, and limited opportunities for the cultivation of commodities with seasonally

complementary needs for labor, the expansion of cottage manufacture can make a significant difference to total productive capacity. Not only are the alternatives for male labor augmented, but putting-out can vastly increase the productive potential of women, whose relative productivity in agriculture and opportunity costs during offpeak periods may be especially low. Cottage production for the market evolves from ordinary production by agricultural households for their own consumption when increases in economy-wide productivity and income boost the size of the market for manufactured products. The availability of entrepreneurs to coordinate the trade, as well as reasonable transportation costs, also play important roles in making putting-out an attractive employment of offpeak labor.

This emergence of substantial cottage manufacturing activity appears to have occurred during the seventeenth and eighteenth centuries in Britain, when major growth in agricultural and economy-wide productivity was first realized. This form of manufacturing organization endured, if not thrived, in many industries throughout these years. However, manufacturing by centralized plants also grew rapidly, and began to displace putting-out even before the widespread diffusion of machinery to manufacturing, which sharply depressed the earnings of cottage workers and virtually eliminated such production in all but a few industries. Our analysis seems able to account for this pattern of development, by relating the expansion of putting-out to the rise in agricultural productivity of the seventeenth century, and its decline to further advances in income, the gradual opening up of the economy to world trade, and the likely widening of the productivity gap between factory and cottage technologies during the late eighteenth century.

In contrast, putting-out manufacture was never very prevalent in the labor-scarce American economy, and was generally dependent on female labor

where it did take hold. With the much higher land to labor ratio, and the related smaller share of agricultural production accounted for by the highly seasonal grains, the opportunity cost of labor in agriculture varied less over the year than in Britain. Accordingly, when increases in income and the expansion of domestic markets induced a growing trade in manufactures, the putting-out organization could not typically compete with central plants except in a few industries where virtually all of the production was carried out by women or children. Some might question our emphasis on the different factor endowments in explaining the divergent patterns of manufacturing organization. The two cases could, for example, be considered incomparable, because the U.S. began to industrialize at a later date after the advance of technologies had raised the advantage of central plants over putting-out. Although we cannot deny the possibility that this factor, or others, contributed to the relatively limited extent of cottage manufacture there, our view is that we are isolating an important source of the contrast between the labor-scarce U.S. and labor-abundant Britain.

Our analysis might be regarded as simply another demonstration of why labor-abundant pre-industrial economies realize low levels of labor productivity, or of how in making most efficient use of their factor endowments, many such societies adopt alternatives to apparent "best-practice" technologies.[39] However, we claim more significance for this treatment of the conditions underlying the contrast between British and American manufacturing organization during early industrialization. Not only is the study of the evolution of, and choices between, forms of manufacturing important in its own right, but this particular case has relevance for the issues of how and whether factor endowment can influence long-term paths of technological development.

Recent estimates of industry-specific manufacturing productivity increase for the two countries during their initial stages of growth have suggested that the U.S. was characterized by a much more balanced record of productivity advance, with rapid progress in both labor-intensive and capital-intensive manufacturing industries, than was Britain.[40] It may be no coincidence that the labor-intensive industries realized virtually no progress in the economy where they were more reliant on the putting-out form of organization. Given the many reasons why centralized plants might yield higher rates of invention and innovation, our framework may help to provide, in the tradition of Habakkuk, an explanation for these disparate patterns of technical change.[41]

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Endnotes

[1]For a sampling of the extensive historical literature on cottage manufacture, or "protoindustrialization," see Franklin F. Mendels, "Protoindustrialization: The First Phase of the Industrialization Process," Journal of Economic History, 32 (June 1972), pp. 241-61; L.A. Clarkson, Proto-industrialization: The First Phase of Industrialization? (London, 1985); and D.C. Coleman, "Proto-industrialization" A Concept Too Many," Economic History Review, 36 (August 1985), pp. 435-448; and Stanley L. Engerman, "Family and Economy: Some Comparative Perspectives," unpublished manuscript, 1988. For recent discussions of the relative productivity of different forms of manufacturing organization, see S.A. Marglin, "What Do Bosses Do?: The Origins and Function of Hierarchy in Capitalist Production," Review of Radical Political Economics, 6 (Summer 1974), pp. 60-112; David S. Landes, "What Do Bosses Really Do?," Journal of Economic History, 46 (Sept. 1986), pp. 585-623; Oliver E. Williamson, "The Organization of Work: A Comparative Institutional Assessment," Journal of Economic Behavior and Organization, 1 (1980), pp. 5-38; S.R.H. Jones, "The Organization of Work: A Historical Dimension," Journal of Economic Behavior and Organization, 3 (1982), pp. 117-137; Oliver E. Williamson, "Technology and the Organization of Work: A Reply to Jones" and "A Rejoinder," Journal of Economic Behavior and Organization, 4 (1983), pp. 56-62 and 67-68; S.R.H. Jones, "Technology and the Organization of Work: A Reply," Journal of Economic Behavior and Organization, 4 (1983), pp. 63-66; and Rick Szostak, "The Organization of Work: The Emergence of the Factory Revisited," Journal of Economic Behavior and organization, 10 (1989), pp. 343-358.

[2]The putting-out organization of manufacture is a specific form of cottage manufacture where there is a division of labor between workers and where proprietors coordinate the flows of raw materials, intermediate products, and final products in and out of households -- where the production (or much of it) takes place. Cottage manufacture could also encompass independent individuals using their homes to produce for the market. Similarly, factories (both mechanized and unmechanized) are only a subset of centralized plants. Since the distinctions between the different types of cottage manufacture and of centralized plants are peripheral to the point of this paper, we will use cottage production and putting out, as well as centralized plants and factories, interchangeably.

[3]For examples of this stage approach to the development of industrial technology, see David S. Landes, The Unbound Prometheus (Cambridge, ENG, 1969); and Paul Mantoux, The Industrial Revolution in the Eighteenth Century (New York, 1962).

[4]Marglin, "What Do Bosses Do?"

[5]Williamson, "Technology and the Organization of Work"; Jones, "The Organization of Work"; and Szostak, "The Organization of Work"; Marglin, "What Do Bosses Do?"; and Landes, "What Do Bosses Really Do?"

[6]For Britain, see Maxine Berg, The Age of Manufactures, 1700-1820 (London, 1985); D.C. Coleman, Industry in Tudor and Stuart England (London, 1975); Ivy Pinchbeck, Women Workers and the Industrial Revolution, 1750-1850 (London, 1930); Ann Kussmaul, A General View of the Rural Economy of England, 1538-1840 (Cambridge, 1990); and George R. Boyer, An Economic History of the English Poor Law (Cambridge, 1990). For the U.S., see Lucy Simler, "Those Who Live By Wages: Agricultural and Industrial Workers in Rural Pennsylvania, 1750-1820," unpublished manuscript, 1988; and Blanche

Hazard, The Organization of the Boot and Shoe Industry in Massachusetts Before 1875 (Cambridge, 1921). For other countries, see Thomas C. Smith, Native Sources of Japanese Industrialization, 1750-1920 (Berkeley, 1988); and Gilles Postel-Viney, "The Dis-integration of Traditional Labour Markets in France: From Agriculture and Industry to Agriculture or Industry," unpublished manuscript, 1991.

[7]For Britain, see Berg, The Age of Manufactures. For the U.S., see Victor S. Clark, History of Manufactures in the United States (New York, 1929), 3 Vols.; Hazard, The Organization of the Boot and Shoe Industry in Massachusetts Before 1875 (Cambridge, 1921); and Rolla Milton Tryon, Household Manufactures in the United States, 1640-1860: A Study in Industrial History (Chicago, 1917). The principal exception to the generalization about the United States is the persistence of highly-skilled handloom weavers in the Philadelphia area well into the nineteenth century; see Philip Scranton, Proprietary Capitalism: The Textile Manufacture at Philadelphia, 1800-1885 (Cambridge, ENG, 1983).

[8]For a discussion of these alternative forms of centralized-plant organization, see Kenneth L. Sokoloff, "Was the Transition from the Artisanal Shop to the Nonmechanized Factory Associated With Gains in Efficiency?: Evidence from the U.S. Manufacturing Censuses of 1820 and 1850," Explorations in Economic History, 21 (October 1984), pp. 351-382.

[9]The paucity of data, especially for Britain, makes a precise quantitative description of the prevalence of putting out in the two countries impossible. Nevertheless, there is essentially universal acceptance of the qualitative comparison because the cottage manufacture appears to have been so widespread in Britain and yet uncommon in the U.S. Perhaps the best discussion of the range of use of putting out in Britain is

Berg, The Age of Manufactures....

[10]Both economies began their pre-industrial eras with skilled artisans working in small shops as the dominant form of manufacturing organization. In the modern industrial age, they are both dominated by the large mechanized manufacturing plant. Hence, it is during the early industrialization that the two countries diverged. Not only did they differ in the relative amount of cottage and factory production, but they also differed in their patterns of productivity growth. In Britain, the labor-intensive industries, which long relied on cottage work, realized virtually no productivity growth during the initial stages of growth -- or through the mid-nineteenth century. The American Northeast had a more balanced record, and the labor-intensive industries increased productivity at nearly the same rate as the more capital-intensive ones, while shifting to the non-mechanized factory as its dominant form of manufacturing organization. Much of this progress was realized through changes in the organization of labor, but many of these industries began to mechanize after 1850. For these estimates of productivity growth during early industrialization, see N.F.R. Crafts, British Economic Growth During the Industrial Revolution (Oxford, 1985); and Kenneth L. Sokoloff, "Productivity Growth in Manufacturing During Early Industrialization: Evidence from the American Northeast, 1820-1860," in Stanley L. Engerman and Robert E. Gallman (eds.), Long-Term Factors in American Economic Growth (Chicago, 1986).

[11]Our model focuses on the allocation of labor during the offpeak periods under grain agriculture because grains were much more seasonal in their labor requirements than any of the other major agricultural outputs of these economies. For twentieth-century estimates of labor-requirements by crop by month, see Benjamin J. Free, Seasonal Employment in Agriculture

(Washington, D.C., 1938). Also see the discussion in Percy W. Bidwell and John I. Falconer, History of Agriculture in the Northern United States, 1620-1860 (New York, 1941), chs. 7-9; Paul W. Gates, The Farmer's Age: Agriculture, 1815-1860 (New York, 1968), especially chpt. 8; Stanley Engerman and Claudia Goldin, "Seasonality in Nineteenth Century Labor Markets," in Donald Schaefer and Thomas Weiss (eds.), Economic Development in Historical Perspective (Stanford, forthcoming); and Joan Thirsk (ed.), The Agrarian History of England and Wales, vol. 5 (Cambridge, 1984) and vol. 6 (Cambridge, 1989). Excluding the possibility that a worker might divide his time between non-grain production and putting out seems inconsistent with indications that rural industry in Britain was sometimes carried out in localities which were relatively specialized in pastoral farming rather than grain agriculture. For example, see Berg, The Age of Manufactures..., p. 103. In a much more elaborate model, however, we could allow for that possibility and obtain the same qualitative results; this level of complexity is not needed to make our basic point about the linkages between the composition of agricultural output, the seasonality of agricultural labor requirements, and the form of manufacturing organization. Moreover, it is unclear how much of the association between pastoral farming and putting out was due to a division of labor between the two activities.

[12]In principle, it is possible that the income effects of a price change can lead to an upward-sloping demand curve; however, in a closed economy general equilibrium model, the price increase raises the real income of producers to exactly the same extent that it reduces the real income of consumers. Hence, there is no net income effect from the price change. This leaves only a pure substitution effect that must be negative.

[13]See the discussion and estimates in John W. Mellor, The Economics of Agricultural Development (Ithaca, 1966), chpts. 3-4.

[14]This proposition is not formally derived above, but is evident from the demonstration that an increase in the stock of land will lead to an outflow of labor from grain production. To achieve this, the harvest wage must decline relative to the wage rates offered in other activities - including putting-out and non-grain agricultural production. Hence, the model implies that an economy with a lower labor-land ratio would have less variation in wages between the peak and offpeak seasons.

[15]Kussmaul, A General View of the Rural Economy...,

[16]Kussmaul, A General View of the Rural Economy..., chpts. 1-2

[17]For example, see Berg, The Age of Manufactures...; and Joan Thirsk, "Industries in the Countryside," in F.J. Fisher (ed.), Essays in the Economic and Social History of Tudor and Stuart England (Cambridge, ENG, 1967). Note that Berg and Thirsk recognize the association of part-time or seasonal production with cottage manufactures, but argue that factors other than agricultural seasonality may contribute to this pattern. For example, Berg emphasizes the large share of cottage workers who were women and children, while Thirsk suggests that an exogenous constraint on the size of landholdings, say from inheritance practices, could also lead to part-time or seasonal manufacturing.

[18]For discussions of the timing of the decline, see Berg, The Age of Manufactures..., chpt. 5; Boyer, An Economic History of the Poor Law, pp. 31-43; and Eric Pawson, The Early Industrial Revolution (New York, 1979). The dominant view appears to be that a relative if not absolute decline had set in by the second half of the eighteenth century, along with a significant shift toward the importation of grains; for trade data, see

B.R. Mitchell, Abstract of British Historical Statistics (Cambridge, 1962), chpts. III and XI. Also David Ormrod, English Grain Exports and the Structure of Agrarian Capitalism, 1700-1760 (Hull, 1985).

[19]See John S. Lyons, "Family Response to Economic Decline: Handloom Weavers in Early Nineteenth-Century Lancashire," Research in Economic History, 12 (1989), pp. 45-91.

[20]In addition to the agricultural output shares of livestock and animal products, the superior diet of the Americans can also be inferred from evidence on nutrition or diet. For example, see Robert W. Fogel et al., "Secular Changes in American and British Stature and Nutrition," Journal of Interdisciplinary History, 13 (Autumn 1983), pp. 445-482. The extreme contrast in diet was probably related to differences in the distribution of income, as well as in the income per worker and relative price considerations treated in the model.

[21]See the work schedules assembled from farmer account books by Winifred Rothenberg, "Structural Change in the Farm Labor Force: Contract Labor in Massachusetts Agriculture, 1750 to 1850," in Claudia Goldin and High Rockoff, (eds.), Strategic Factors in Nineteenth Century American Economic History: A Volume to Honor Robert W. Fogel (Chicago, 1991). Other scholars of northern agriculture have also found that agricultural laborers were typically employed at agricultural jobs, rather than manufacturing, during the winter months. For example, David E. Schob, Hired Hands and Plowboys: Farm Labor in the Midwest, 1815-60 (Urbana, 1975).

[22]The ratios of the wheat price to nail and cotton yard prices were computed for both countries, over the years from 1784-1808 (grain to nail price) and 1819 to 1834 (grain to cotton yard price). They were consistently and significantly higher for Britain, and exhibited a slight

tendency toward convergence. The U.S. prices were for Philadelphia and Cincinnati and drawn from Anne Bezanson, Robert D. Gray, and Miriam Hussey, Wholesale Prices in Philadelphia, 1784-1861 (Philadelphia, 1937); and Arthur H. Cole, Wholesale Commodity Prices in the United States, 1700-1861 (Cambridge, 1938). The British prices were drawn from Sir William Beveridge, Prices and Wages in England: From the Twelfth to the Nineteenth Century (London, 1939); B.R. Mitchell, British Historical Statistics (Cambridge, 1988); and James A. Mann, Cotton Trade of Great Britain (London, 1860) for nails, grain, and cotton yard respectively.

[23]Engerman and Goldin, "Seasonality...," and Postel-Vinay, "Dis-integration...".

[24]Postel-Vinay, "Dis-integration...".

[25]See the discussion in Coleman, Industry in Tudor and Stuart England, p. 37. For estimates of the amounts of fixed capital per worker by industry, see Kenneth L. Sokoloff, "Investment in Fixed and Working Capital During Early Industrialization: Evidence from U.S. Manufacturing Firms," Journal of Economic History, 44 (June 1984), pp. 545-556. Also see Landes, Unbound Prometheus, pp. 118-119.

[26]See Sokoloff, "Was the Transition..."; and the discussion of how employers in early factories tried to reduce labor turnover and absence in Pawson, The Early Industrial Revolution, pp. 92-93.

[27]Although there were adult males employed in cottage manufacture of boots/shoes, they composed a markedly smaller proportion of the labor force in putting-out enterprises than in firms with centralized production plants (as in other industries). Moreover, the males employed by the former appear to have been disproportionately represented among the workers involved in cutting, treeing, and varnishing, which were typically performed

in the central shop that coordinated the operations of the firm. Even among those laboring outside the shop, there was a tendency to gather and work in groups at a particular location. See Hazard, Organization of the Boot and Shoe Industry.... The overwhelming majority of firms covered in the McLane Report were organized with centralized production. It is clear from both their actual reports, as well as through the descriptions of enumerators, that they tended to operate virtually year-round. Although the firm-level of output probably varied over the seasons, only putting-out establishments seem to have typically shut down for an extended period.

[28]U.S. House of Representatives, Documents Relative to the Manufactures..., Vol. I, pp. 27, 238-39, 256-57, 303, 312-13.

[29]See the discussion in Hazard (p. 85) of how enterprises who put out for cottage production of shoes typically had a central shop for finishing and other skilled tasks.

[30]There are at least two reasons to expect that the differences are underestimated. First, to the extent that our method of distinguishing the two types of firms is inaccurate, the groups will be contaminated and the averages biased toward each other. Second, since some of the employees of putting-out enterprises, such as those in the central coordinating shops, performed their assigned tasks under a factory-like regime (together with other workers, on a regular schedule, and presumably with supervision) and may have worked more hours per year, their levels of compensation and productivity may not reflect those of pure cottage producers. Another way of gauging the level of productivity or the seasonality of cottage manufacturing is to compare the average daily wage rates of shoemakers engaged in putting-out with those of other manufacturing workers in the same geographic locality. This method yields the same qualitative conclusions:

either putting-out workers were much less productive (and received lower compensation) than workers in other industries or under centralized-plant organizations, or they labored at manufacturing fewer hours a year. Although their annual earnings from adult male manufacturing were lower, cottage workers presumably amassed total annual earnings similar to those of factory employees by laboring in agriculture during peak periods.

[31]Close examination of the data provided by enterprises judged likely to rely on putting-out production suggests that they generally computed their average daily wage from information on the total wage bill to a class of employees together with the respective number of employees, and spread the average annual compensation over a 310-day standard. There is not enough detail to estimate how the number of workhours or workdays per year varied by organization of the firm or class of employees.

[32]For more discussion of this and related points, see Claudia Goldin and Kenneth Sokoloff, "Women, Children, and Industrialization in the Early Republic: Evidence from the Manufacturing Censuses," Journal of Economic History, 42 (Dec. 1982), pp. 741-774; and Claudia Goldin, Understanding the Gender Gap: An Economic History of American Women (Oxford, 1990).

[33]As Hazard discusses in Organization of the Boot and Shoe Industry..., all manufacturers of boots and shoes at this time utilized roughly the same types and amounts of tools per unit of labor. Production relied on handtools, as sewing machines and other sophisticated capital equipment had yet to be introduced. Enterprises differed primarily in scale and in the way in which labor was organized. So-called artisanal shops operated at a smaller scale with a few highly-skilled workers producing a relatively high-quality and differentiated product; putting-out enterprises operated at a larger scale with extensive division of labor, and produced a lower-quality

standardized product; and so-called non-mechanized factories sought to exploit potential gains from both division and intensification of labor in their manufacture of a standardized product. In his study of early-nineteenth century manufacturing, Sokoloff argued that non-mechanized factories were able to achieve higher levels of productivity than artisanal shops through greater division and intensification of labor within the firm. It thus seems quite feasible for centralized plants to have attained higher levels of productivity than firms relying on cottage workers. Artisanal shops were able to survive in competition with non-mechanized factories due to markets segmented by transportation costs and differentiated products. In a similar fashion, putting-out enterprises may have been able to compete even though they were less productive, because of their lower labor costs. See Sokoloff, "Was the Transition...". One would expect that workers would require a compensating differential in wages to labor under the more intense work regime of the factory. Hence, this mode of manufacturing organization would only be able to displace the other in competition if it raised productivity more than enough to both compensate the workers and yield a higher return to capital.

[34]As Pawson observes, "wages in the factories were appreciably higher than in domestic trades, and the work was regular." See his The Early Industrial Revolution, p. 93.

[35]Such a project is in progress.

[36]For example, the labor-saving technical change realized in eighteenth-century English agriculture could have contributed to a decline in the seasonality of labor requirements. See Robert C. Allen, "The Growth of Labour Productivity in Early Modern English Agriculture," Explorations in Economic History, 25 (June 1988), pp. 117-146.

[37]For a nice study of this subject, see Sarah F. McMahon, "A Comfortable Subsistence: The Changing Composition of Diet in Rural New England, 1620-1840," William and Mary Quarterly, 42 (Jan. 1985), pp. 26-65.

[38]Although he differs from other scholars in arguing that the decline in ocean freight rates accelerated sharply in the late-nineteenth century, see C. Knick Harley, "Ocean Freight Rates and Productivity, 1740-1913: The Primacy of Mechanical Invention Reaffirmed," Journal of Economic History, 48 (Dec. 1988), pp. 851-876; and Ormrod, English Grain Exports....

[39]For a classic treatment of development problems arising from surplus labor, see W. Arthur Lewis, "Economic Development With Unlimited Supplies of Labor," in A.N. Agarwala and S.P. Singh (eds.), The Economics of Underdevelopment (Oxford, 1973).

[40]Note the contrast in the estimates of total factor productivity growth realized by manufacturing industries during early industrialization. Crafts, British Economic Growth..., sees an unbalanced pattern, with the mechanized industries making virtually all of the progress. Sokoloff, "Productivity Growth...," finds a more balanced pattern, with the labor-intensive industries doing nearly as well as the capital-intensive or mechanized ones.

[41]H.J. Habakkuk, American and British Technology in the Nineteenth Century (Cambridge, 1962), and Landes, Unbound Prometheus, chpt. 2.