Craig Heinicke and Wayne A. Grove

Labor Markets, Regional Diversity, and Cotton Harvest Mechanization in the Post–World War II United States

As hand-harvest labor disappeared from the American cotton fields after World War II, labor market dynamics differed between two key production regions, the South and the West. In the South, predominantly resident African Americans and whites harvested cotton, whereas in the West the labor market was composed of white residents, domestic Latino migrant workers, and Mexican nationals temporarily immigrating under the sponsorship of the U.S. government (braceros). We use newly reconstructed data for the two regions and estimate for the first time the regional causes of the demise of the hand-harvest labor force from 1949 to 1964. Whereas cheaper harvest mechanization substantially affected both regions, the downward trend in cotton prices and government programs to control cotton acreage played important roles in the disappearance of hand-harvested cotton in the South, but not in the West.

At the end of World War II, cotton remained largely unmechanized in contrast to the greater part of American agricultural production. Millions of workers from California to the Carolinas spent long days picking cotton fields—once, twice, three times as the cotton continuously matured. This harvest ritual, almost as old as the nation itself, disappeared for good in the 1970s. Gone from American cotton fields were the tenant and sharecropper shacks, migrant tents, cotton-picking crews transported from towns in flatbed trucks, the drudgery of gathering the crop by hand, the singing in the fields, and a school year dominated by the crop cycle.[1] Instead, tens of thousands of machines lumbered through the fields with metal spindles whirling

Social Science History 29:2 (summer 2005), 269–97

through the cotton plants and plucking off the white lint. The purpose of this essay is to estimate and compare the causes of the decline in cotton harvest labor in the West and in the South. Existing studies by Wayne Grove and Craig Heinicke (2003) and Willis Peterson and Yoav Kislev (1986) analyze the entire transcontinental cotton belt without considering variations by regions.[2]

Our regional analysis is premised upon well-examined differences in production practices in each area and a novel explanation for the logic of those differences. In the South, large landowners primarily relied upon tenant, sharecropper, and resident wage laborer families, supplemented by day-haul labor, to gather their cotton crop. Families with small plots of land harvested their own crop. By contrast, in the West—New Mexico, Arizona, and California—growers employed what local day-haul labor they could and then relied upon migrants as well as braceros, Mexican contract labor employed under the Mexican Farm Labor Program, referred to as the Bracero Program (the latter authorized by a significant exemption to the Immigration and Naturalization Service Act). As argued below, these differences in labor market arrangements and production organization constitute mechanisms, adapted to local geoclimatic conditions, to prevent cotton quality deterioration. The labor forces of these two regions differed with respect to their racial and ethnic compositions as well. The South's labor force was composed mainly of African Americans and whites. In the West, whites and Latinos—both Mexican nationals and domestic migrant workers—primarily formed the labor force.

In both the West and the South, our results indicate that reductions in labor demand caused more of the mass exodus of workers from the cotton fields than did reductions in labor supply.[3] The effects of specific contributing factors varied markedly by region.[4] In the South, decreased labor demand resulted from mechanization, decreasing cotton prices, and a federal farm program—the Soil Bank—which provided a financial incentive for farmers to reduce cotton acreage. In the West, mechanization reduced labor demand, but cotton prices, government acreage programs, the draw of nonagricultural wages, and the Mexican farmworker program played minor roles.[5]

Regional Differences in Labor Market Arrangements and Production Organization

Following the Civil War, a system of cotton production in the South developed based on the southern plantation: large-scale landownership fragmented into small plots and farmed by families who rented the land for either cash or a share of the crop. These planters typically cultivated some of their holdings using year-round hired hands and day laborers during the harvest, with a foreman managing the operation. A substantial portion of the harvest workforce for the northern Arkansas Delta area, for example, commuted daily by bus from Memphis.[6] Small-scale landowners performed all tasks with family labor. During World War II and throughout the 1950s, growers, aided by state farm placement officials, more actively recruited nonresident labor from other parts of the state (such as the hill sections of the Delta states) and from south Texas (Coalson 1977; Day 1967; U.S. Department of Agriculture 1947: 64–68). Thus, resident labor harvested the vast majority of the southern crop, although growers near villages, towns, and cities supplemented their workforce with day-haul labor (table 1).

Although characterized as a zone of exclusively migrant labor (Whatley 1991), growers in the West employed a diverse labor force (table 1). Based on the rise of irrigated agriculture, the cultivation of much more cotton acreage per operator, and the advent of truck transportation following World War I, growers from Texas westward employed whatever local day-haul labor existed. Growers transported workers, who assembled in designated locations, to and from the fields each day. Many resident workers had migrated from the Plains during the dust bowl years (Weber 1994). To satisfy unmet demand for seasonal workers, growers employed migratory labor crews that followed the maturing cotton harvest as the season advanced. The pre–World War II annual migration in Texas, known as the big swing, consisted of 75 percent Mexicans or Mexican Americans, 15 percent whites, and 5 percent blacks (Evans 1941: 197). Migrant workers typically traveled together in groups, usually under the direction of a male crew leader and with extended family members as the core of the crew.[7] With a truck and the ability to speak English, the crew leader recruited, hired, and transported workers and made all the work arrangements. Acting as the intermediary between the grower and the workers, the crew leader usually weighed the cotton in the field and hauled it to the gin. The farmer paid the crew leader for each trailer load of

Table 1 Cotton harvest labor shares (percentages), 1950s average, by region of the United States

Type of labor	West	South
Local	52	90
Migrant	25	5
Foreign	23	5

Sources: See Grove 2000.
Note: State shares of each type of labor are weighted by the state share in total production. West includes Arizona, California, and New Mexico. South includes Alabama, Arkansas, Georgia, Louisiana, Mississippi, Missouri, North Carolina, South Carolina, and Tennessee.

seed cotton as weighed by the gin and then the crew leader disbursed the funds to his workers.

The Cotton Harvest Problem

To maximize the potential yield, growers adopted production practices best suited to the soil and microclimate and to protecting plants from adverse weather conditions, the boll weevil and other insects, weeds, and assorted plant diseases. At the end of a long gauntlet of climatic, biological, and other dangers, a mature crop of cotton in the field represented a year's investment of time and money and stood ready for harvest or ruin. Ruin came in many forms. During the time of harvest, danger loomed in the form of field and grade losses. Storms, whether wind, hail, rain, or sand, threatened to dislodge the cotton from the bur. Field losses resulted if the lint became too muddy or dirty or because the seed attached to the fiber germinated. International commodity markets valued cotton lint according to its grade (i.e., whiteness and cleanliness) and staple length. Cotton fetched its highest price when newly opened and of its maximum length, whiteness, and cleanliness. Grade losses resulted due to staining from green leafy material or if lint contained organic and inorganic debris, either due to contamination during the harvest or as a result of storms. In addition, the combination of high heat and humidity caused the growth of microorganisms on cotton fibers, which discolored it.[8] Thus, the exposure to such atmospheric conditions in the field or in storage before ginning threatened to lower the crop's value.

The growers' cotton harvest problem, then, was to prevent field and grade losses relative to the expense of doing so. Cotton plants continuously

and systematically develop new bolls, typically for a two- to three-month harvest season, until either cold weather drastically slows the process or a killing frost terminates it. Growers typically conducted two to three harvests. Although all growers sought to bank a clean and rapid harvest, timeliness mattered and varied systematically such that the southern harvest problem imposed considerably greater challenges than experienced in the West. For example, in the humid South, morning and evening dews limited the picking hours per day (because wet cotton did not gin as well and experienced accelerated bacteria growth if stored) and soggy fields kept both workers and machines from the crop. Therefore, southern growers had fewer and less predictable harvest hours available to gather their cotton. Precipitation also increased the incidence of weeds and foliage on the cotton plant, elevating the humidity level in the fields, and threatened to stain the lint if the harvest was not conducted carefully. Growers in the semi-arid West, on average, had three times as much time to gather their lint as did planters in the Mississippi Delta and five times as much as southeastern farmers (Meier 1969: 214–19).[9]

The vagaries of nature and plant growth meant that growers knew neither when the harvest would begin nor the number of hours available to gather the crop. The long period of production and the inability to substitute labor inputs across time exposed cotton producers to temporary absences and random quits before the crop was completely harvested, especially in the post–World War II era of rapid economic growth and ample nonfarm employment opportunities—a matter about which farmers perennially complained. Employers incurred transactions costs when hiring harvest labor services, varying costs that depended on the amount of time and trouble spent to obtain replacements, agree on terms of employment, and enforce them. A study of California farmers in the Coachella Valley, for example, listed the chief disadvantages of domestic workers: lack of reliability (45 percent), lack of family housing (26 percent), unavailability during hot weather (18 percent), and drinking (6 percent) (McDonagh 1955: 17). "Absenteeism of workers in the cotton fields," according to the Arizona State Employment Service, "is a problem of such magnitude that many farmers estimate their labor requirements could be reduced by one-third if the work force in the fields could be kept at work during all of the hours and days available for work" (Arizona State Employment Service 1951: 14). Growers attributed both rising field and grade losses and dwindling hand-harvest productivity to the rural exodus of the best young male workers for distant cities and the rising proportion of

women, children, and older men (Lindsey and Heagler 1967: 7; Meier 1969: 262–67). Despite grower complaints of declining picking speed in the Mississippi Delta, data for Arizona indicate a slight increase (Lindsey and Heagler 1967; Arizona State Employment Service 1960).

Unpredictable weather conditions simultaneously introduced uncertainties in workers' supply of harvest labor. Workers who picked the cotton crop spent tedious and exhausting days bending down and reaching up to gather the white bolls. Because they did not know the timing, duration, and amount of harvest employment long beforehand, workers attempting to maximize earnings could neither make precise plans nor count on a certain amount of harvest income (Fisher 1952). This was especially true for migrants who had to make costly arrangements across long distances. Thus, workers had an incentive to move on when news arrived of better pay and crop conditions elsewhere. Such labor supply uncertainty encouraged growers to attempt to manipulate labor markets by hoarding labor and preventing the out-migration of workers and by collectively attempting to impose regional wage ceilings. In the 1950s, state farm placement officials helped improve worker-grower communication and structure the migratory and day-haul labor markets (Coalson 1977). Local laborers, unwilling or unable to work away from home, chose from among fewer employment options and offered growers a more reliable workforce.

Regional Solutions for the Cotton Harvest Problem

In our view, sharecropping and the plantation functioned to minimize harvest-time grade and field losses.[10] Without knowing how many workers would be needed, farmers could not solve the cotton harvest problem by simply contracting for picking services at the beginning of the season. Annual labor contracts ameliorated those uncertainties and functioned as labor supply insurance for landowners as well as unemployment insurance for workers. In the context of the cotton harvest problem, southern cotton growers' reliance upon sharecropping and the plantation functioned as quality preservation mechanisms in the following two ways. First, the plantation secured an on-site workforce with tenant and sharecropper shacks and cabins located adjacent to the fields, and used a centralized manager to organize production. With limited harvest hours available, a rapid and timely mobilization of the

workforce occurred when the crop needed attention. The bell system, which allowed a central manager to communicate with a disbursed labor force, permitted coordination of work over a vast production area of scattered fields (Woofter et al. 1936). The importance of lint moisture content and the daily gin capacity could be used to dictate production decisions, such as the beginning and ending of each day's harvest, to maintain cotton quality. In addition, tenancy and sharecropping helped prevent quality deterioration by providing workers an incentive to pick the cotton cleanly because such workers received either all or a share of the value of cotton with a higher grade. A clean pick was simply a more formidable challenge in the humid South, as described above.[11]

In the semi-arid West, by contrast, growers faced much less urgency in harvesting the crop and greater availability and predictability of harvest hours. Consequently, western growers relied upon available local labor and crews of migrants of uncertain numbers, quality, and duration. Thus, the distinct regional configuration of labor market arrangements and production organization constitute locally adapted institutions and practices that are the result of distinct, path-dependent regional histories and, at least partially, geoclimatic differences.

Cotton Harvest Labor Market

Cotton remained a relatively new enterprise in the West at the beginning of the period examined here, having expanded from a minimal share of U.S. production in the 1930s to 15 percent by 1950 (figure 1). The South, by contrast, produced slightly over half of the cotton grown in the United States. Growers in the Southwest (Texas and Oklahoma), a region that combined socioeconomic and climatic characteristics of both the South and the West, produced the remainder.[12] World War II led to an upsurge in mass outmigration from the South, largely of African Americans to northern urban centers, and disrupted migrant flows in the West (Johnson and Campbell 1981; Street 1957: 197–98). Whereas real farm wages drifted back downward following World War I, real cotton-picking pay more than doubled during the Second World War and remained high afterward (Wright 1986; Musoke and Olmstead 1982: 399). Many growers viewed the situation as fighting to preserve a way of life in the face of a variety of long-run threats. In addition to the acceleration of rural-urban migration, the unintended consequences of non-

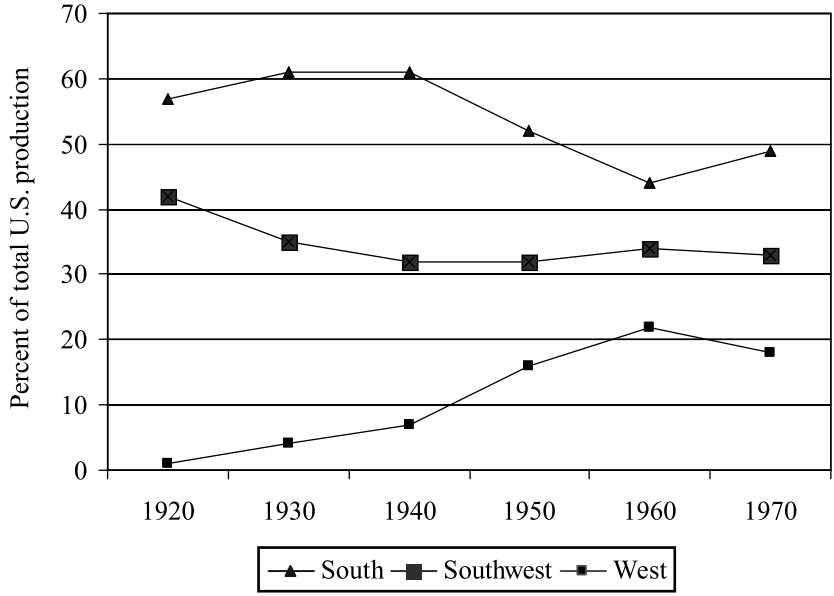

Figure 1 U.S. cotton production share by region, 1920–70

Note: South includes Alabama, Arkansas, Georgia, Louisiana, Mississippi, Missouri, North Carolina, South Carolina, and Tennessee. Southwest includes Oklahoma and Texas. West includes Arizona, California, and New Mexico.

market, governmental solutions (i.e., federal government programs to limit crop supply), initially intended to support farm incomes, undermined the traditional system by further fostering out-migration. Other threats included increased competition from synthetic fibers and foreign cotton producers (National Cotton Council of America 1947).

The increased labor scarcity that emerged during and after the war provided new impetus for the creation of a viable cotton-harvesting machine (Wright 1986; Holley 2000; Street 1957). After years of experimentation and backyard tinkering by the Rust brothers and others, in 1948 International Harvester began production of a mechanical spindle picker. This machine replaced human fingers with moistened spindles that rotated through the plant and pulled out the cotton fiber. Other manufacturers soon offered similar machines. Once mass-produced, western growers rapidly adopted the mechanical cotton harvester, followed by planters in the South (see figure 2). Machine harvest costs fell steadily and markedly over our period of analysis (Meier 1969). Newly assembled data reveal that relative harvest costs favored

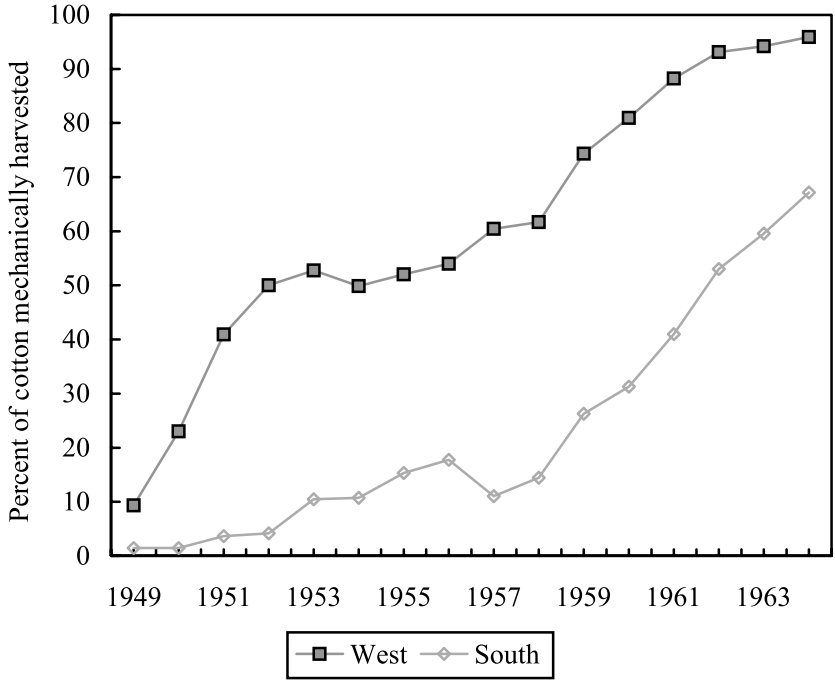

Figure 2 Percentages of cotton machine harvested by region, 1949–64

Note: South includes Alabama, Arkansas, Georgia, Louisiana, Mississippi, Missouri, North Carolina, South Carolina, and Tennessee. West includes Arizona, California, and New Mexico.

mechanization at the beginning of our period in the West, but not until late in the 1950s in the South (Grove 2000). In addition to machine costs, the pattern of technological change resulted from lower southern hand-harvest costs and from higher utilization rates in the semi-arid West compared to the humid South.[13]

Although the transformation from hand to machine cotton harvesting typically is attributed to either cheaper machines (reduced labor demand) or the lure of industrial wages or better opportunities outside of agriculture (decreased labor supply) (Peterson and Kislev 1986; Holley 2000), many other factors influenced the demise of the hand-harvest workforce. The government, as it had in the 1930s, played an important role in limiting the amount of acreage that growers planted in cotton by the use of cotton allotments, which were in force in 1950 and from 1953 to 1964.[14] A less appreciated acreage-reduction effort, the Soil Bank program, directly paid growers

Table 2 Soil Bank program average annual cotton acreage and production

	Acreage planted (1,000s)		Cotton production (1,000s of bales)	
	South	West	South	West
1951–53	11,026	1,976	7,314	2,683
No acreage allotments	(85)	(15)	(73)	(27)
1954–55	10,965	2,096	7,361	2,450
Acreage allotments	(84)	(16)	(75)	(25)
1956–58	6,001	1,273	5,172	2,577
Soil Bank and acreage allotments	(82)	(18)	(67)	(33)
Percentage change 1954–55 to 1956–58	−45	−39	−30	5

Source: USDA 1974: 64–77.
Note: The percentages of the West and South totals are in parentheses.

per acre they withdrew from production. Both acreage reduction initiatives sought to eliminate surplus production, but the Soil Bank functioned as a farm income maintenance program.[15] The Soil Bank was in effect in the years 1956–58 and 1964. In the year 1958, 4.9 million planted acres, or 29 percent of the 1956 acreage, were diverted (Cochrane and Ryan 1976: 225). Payments to growers reflected the potential earnings from planting the crop on land of average quality, but without incurring risk.[16] With such incentives, cotton acreage fell abruptly in the South, where growers with marginal land sought opportunities that were more profitable and readily accepted government payments to divert acreage and other resources away from cotton (see table 2). When the Soil Bank acreage reserve plan was suspended in 1959, cotton acreage returned to its previous level in much of the South, although not on marginal lands particularly in Alabama, the Carolinas, and Georgia (Heinicke 1997). By contrast, western producers could do as well or better planting cotton and devoting resources to increase cotton yields. In 1958, the year of the greatest reductions in land planted to cotton under the Soil Bank program, growers in Alabama and Georgia planted 52 percent and 43 percent of their allotted acreages, while New Mexicans, Arizonans, and Californians planted more than 90 percent of their allotted acreages (calculated from U.S. Department of Agriculture 1974).

Despite these supply-reduction programs, cotton prices fell steadily after World War II and formed part of the impetus for marginal producers to divert land and capital to other enterprises (see Fite 1984; Heinicke 1997;

Daniel 1985; Kirby 1987). Price declines resulted from increased competition with synthetic fiber production and cheaper foreign producers (Jacobson and Smith 2001). In addition, cotton prices declined as more efficient and higher-yielding western producers expanded their share of output—western yields in the 1950s were twice as high as those in the South. High yields in the West meant that output actually increased there during the Soil Bank years, whereas it decreased in the South (table 2). The disappearance of the Old South coincided with the demise of cotton in that region as production shifted from the Southeast (the Carolinas, Georgia, and Alabama) to the Mississippi Delta and West where cotton yields were higher (Heinicke 1997; Grove and Heinicke 2003).

Model of the Hand-Harvest Labor Market

The fundamental differences in labor organization in the South and West constituted natural laboratories to examine how changes in labor supply and demand during the period of harvest mechanization affected these regions. We separately estimate the shifts in the supply of and demand for cotton harvest labor for the South and West. Equations 1 and 2 show the key variables measured by state from 1949 to 1964. The demand for hand labor (Qd) is a function of the cotton harvest wage (W), machine costs ($MCOST$), the (lagged) price of cotton (PCT), grower overhead expenses ($OVERH$), the two government acreage-restriction programs ($ALLOT$ and $SOIL$), yield (Y), and state dummy variables (see Grove and Heinicke 2003):

$$(1)\quad Qd_{ti} = \alpha_0 + \alpha_1 Q_{t-1,i} + \alpha_2 W_{ti} + \alpha_3 MCOST_{ti} + \alpha_4 PCT_{t-1,i} + \alpha_5 OVERH_{ti} + \alpha_6 ALLOT_{ti} + \alpha_7 SOIL_t\ \alpha_8 Y_{ti} + \alpha_{9i} SD_i + \varepsilon_{dti}.$$

Since no complete series exists regarding the number of hours required to harvest a given amount of cotton, we measure the amount of harvest labor (the dependent variable) by the total quantity of cotton harvested by hand. Lagged output is entered on the right-hand side to account for the notion that cotton planters adjust their labor demand over time, not instantaneously, due to adjustment costs that prohibit immediate movement to the desired level (see Nerlove 1958 on such partial adjustment models).[17] Total compensation of labor (per pound of lint) employed in the cotton harvest (W), that is, the cash wage added to the value of in-kind benefits, forms the wage variable (Grove 2000). Grove (ibid.) estimated a time series of hand-harvest costs to

match the Meier 1969 machine cost data by (1) converting piece-rate wages to cash wages per pound of lint and (2) estimating nonwage costs for resident laborers, day-haul workers, domestic migrants, and foreign contract workers. Determination of nonwage expenses required estimating the annual cotton harvest labor shares of each type of labor by state from 1949 to 1964 because harvest organization and recruitment expenses and in-kind compensation varied for each. Annual state hand-harvesting costs were obtained by combining state wage and nonwage labor expenses, weighted according to the types of labor employed (Grove 2000). We also added separately the overhead costs of hand pickers (*OVERH*) to address the fact that landowners incurred noncash costs associated with organizing the harvest and recruiting a workforce and the fact that workers did not receive this as part of the wage (ibid.). The estimated costs per pound of lint cotton by machine picking (*MCOST*) are entered to measure harvest mechanization, a key variable for both regions (ibid.).[18] That growers' decisions were made on the basis of the expected output price is measured by the price of cotton lagged one year (*PCT*). In part, cotton prices declined throughout our period of analysis as synthetic fiber production increased and producers abroad intensified production (Grove and Heinicke 2003; Heinicke 1997). Such adverse output price movements may have caused growers to divert cotton acreage to other crops or pasture or from farming altogether. The hand-harvest quantity demanded rose along with cotton yields (Y), the cotton-to-land ratio.

Government farm programs paid producers to reduce cotton planting. Federal acreage allotments (*ALLOT*) provided maximum cotton acreages for most years in the 1950s, limiting labor demand (Heinicke 1997).[19] Without systematic data of the number of diverted acres, we proxy the Soil Bank program using a dummy variable for the years in force. Finally, we include dummy variables for each state (*SD*).

Equation 2 shows the cotton harvest labor supply function (see Grove and Heinicke 2003):

$$(2)\quad Qs_{ti} = \beta_0 + \beta_1 Q_{t-1,i} + \beta_2 W_{ti} + \beta_3 WNON_{ti} + \beta_4 Y_{ti} + \beta_5 PREHW_{ti} + \beta_6 ACRES_{ti} + \beta_{7i} SD_i + \varepsilon_{Sti}.$$

Lagged output and the wage are measured as in the demand function. To measure wages outside of the cotton harvest labor market, we composed a measure based on average manufacturing wage rates (*WNON*). This measure averages the manufacturing wage rates in both the origin and the pri-

mary destination states of interregional migrants to the North. To control for wage expansion and compression, the average wage rate in manufacturing is adjusted by the ratio of the average earnings for "laborers" and "operatives" to the overall average in manufacturing for each state in the 1950, 1960, and 1970 census years and interpolated linearly.[20] Regional cost of living adjustments were also made (taken from Williamson and Lindert 1980).

Cotton yield (Y) is also included in the supply equation. Yields were positively related to harvest-period employment; labor supply was a positive function of such seasonal income for a given wage rate.[21] We add cotton acreage planted ($ACRES$) and the average wage rate in agriculture by state ($PREHW$) to the supply function to reflect the variation in hours of weeding and other preharvest activities; a reduction in preharvest income meant less annual income, which encouraged out-migration, reducing the harvest labor supply (see Heinicke 1999; Whatley 1987). State-level dummy variables (SD) are included to account for variations in relocation costs as well as other omitted variables. Because landowners purchased goods and sold cotton in national markets, the U.S. Consumer Price Index is used to deflate nominal price variables. Means and growth rates of variables by region are shown in table 3.

Empirical Results

We use two-stage least squares to estimate the supply and demand for hand-harvested cotton, with separate functions for the two regions, pooling the annual state-level data within each region (nine southern and three western states) and treating Q and W as endogenous. Table 4 reports the results of the structural model.[22] Since all data are in logs, the coefficients can be regarded as elasticities.[23]

The results are as expected for the main variables of interest, with a few exceptions. Machine-harvesting costs, on the labor demand side, and nonagricultural wage rates, on the supply side, exhibit coefficients of the expected signs in both the South and the West. In the South, the Soil Bank and cotton price coefficients are of the expected signs, although this is not the case in the West. We discuss this more fully when we evaluate the relative magnitude of various demand and supply shifts. Also, the estimated harvest wage elasticity of supply is virtually identical in the West and South, but the demand elasticity is of the wrong sign in the West. In the following analy-

Table 3 Descriptive statistics, 1950–64

A: Means and standard deviations of raw variables in regressions

Variable	South $n \times T = 135$ Mean	South $n \times T = 135$ Standard deviation	West $n \times T = 45$ Mean	West $n \times T = 45$ Standard deviation
Hand-harvested cotton (per 1,000 bales)	544.49	364.08	325.74	238.21
Labor compensation (¢ per lb. of lint)	10.22	2.15	11.90	2.05
Cotton price (¢ per lb. of lint)	37.43	4.23	38.09	4.98
Mechanical harvesting costs (¢ per lb. of lint)	9.21	2.07	5.44	1.38
Overhead costs of labor (¢ per lb. of lint)	0.99	0.23	0.61	0.21
Nonagricultural wage rates ($ per hr.)	1.53	0.20	1.96	0.20
Cotton yields (lbs. per acre)	405.64	111.22	820.37	300.23
Preharvest agricultural wage ($ per hr. without room or board)	0.65	0.13	1.00	0.16
Planted cotton acreage (1,000s)	954.8	569.4	524.91	326.7
Cotton allotment (1,000s × years in effect: $n \times T = 108$ South; 36 West)	892.49	434.17	483.19	272.19
Soil Bank dummy	0.27	0.44	0.27	0.44
Braceros (relevant years, $n \times T = 32$)			11,184	6846

B: Growth rates

Estimated from $\log(x) = a + rt + sd + e$	$\hat{r}$ South	$\hat{r}$ West
Hand-harvested cotton	−0.072	−0.180
Labor compensation	−0.026	−0.027
Cotton price	−0.019	−0.019
Mechanical harvesting costs	−0.040	−0.057
Nonagricultural wage rates	0.016	0.019
Cotton yields	0.041	0.031
Overhead costs of labor	0.044	0.056
Preharvest agricultural wage	0.013	0.008
Allotment (relevant years, $n \times T = 108$ South, 36 West)	−0.014	−0.009
Planted cotton acreage	−0.046	−0.019

Data source: State-level averages or aggregates; see text for description.

Note: All money values are expressed in constant (1960 = 100) dollars. 1949 was omitted due to the lag used in estimation.

Table 4 Two-stage least-squares estimates, cotton hand-harvest labor market

	South		West	
Independent variables	Demand	Supply	Demand	Supply
Lagged hand-harvested cotton Q_{t-1}	0.63	0.36	0.69	0.71
	(11.45)	(6.54)	(7.28)	(8.51)
Labor compensation (W)	−0.38	1.01	0.79	1.01
	(−0.66)	(3.66)	(0.80)	(2.05)
Lagged cotton price (PCT)	1.25		−0.27	
	(1.88)		(−0.31)	
Mechanical harvesting costs (MCOST)	1.02		1.38	
	(5.42)		(2.32)	
Overhead costs of labor (OVERH)	0.05		−0.03	
	(0.24)		(−0.14)	
Cotton allotment (ALLOT)	−0.01		−0.08	
	(−1.66)		(−2.34)	
Soil Bank dummy (SOIL)	−0.23		0.08	
	(−6.98)		(0.84)	
Nonagricultural wage rates (WNON)		−1.78		−2.65
		(−2.63)		(−1.50)
Cotton yields (Y)	0.77	0.90	1.29	0.86
	(8.94)	(10.30)	(2.91)	(1.83)
Preharvest agricultural wage (PREHW)		−0.98		−0.84
		(−2.46)		(−0.45)
Planted cotton acreage (ACRES)		0.33		0.28
		(3.81)		(1.17)
Braceros				0.037
				(3.10)
State dummy variables (SD)				
Arkansas	0.29	−0.42		
	(2.01)	(−1.41)		
Georgia	−0.12	−0.44		
	(−1.75)	(−2.86)		
Louisiana	−0.21	−0.39		
	(−2.55)	(−4.70)		
Mississippi	0.31	−0.43		
	(4.16)	(−2.98)		
North Carolina	−0.18	−0.79		
	(−0.82)	(−4.35)		
South Carolina	−0.13	−0.65		
	(−2.11)	(−5.09)		

Table 4 (continued)

	South		West	
Independent variables	Demand	Supply	Demand	Supply
Tennessee	−0.15	−0.37		
	(−1.48)	(−4.14)		
Missouri	−0.19	−0.74		
	(−0.68)	(−3.11)		
California			0.05	0.41
			(0.37)	(0.85)
New Mexico			0.22	0.36
			(0.58)	(1.18)
Intercept	−8.07	−5.11	−10.03	−7.15
Adjusted R^2	0.95	0.93	0.94	0.95
$n \times T$	135	135	45	45

Data source: State-level averages or aggregates; see text for description.
Notes: Dependent variable = quantity of hand-harvested cotton. See text for estimation method.
t-statistics in parentheses (using adjusted standard errors).
Omitted state dummies: South: Alabama; West: Arizona.

sis, we use a demand elasticity from a study of hired labor for a comparable period in the West.

We decompose the influence of the variables outlined above on the demise of hand-harvested cotton in tables 5 and 6. We begin with a numerical example. In the second column of numbers in tables 5 and 6, we report the annual horizontal shifts in the demand and supply functions, obtained by multiplying the average annual rate of change in the exogenous variable by its estimated coefficient. In the South, machine-harvest costs per pound of lint, for example, declined on average by 4.0 percent per year during the period. Cheaper machine harvesting shifted demand for hand-harvest labor to the left at an annual rate of 4.1 percent (−4.0 × 1.02; the latter is the coefficient of *MCOST* in table 4). Each variable's effect on the change in (endogenous) wages is determined by multiplying the shift in the function (what we just described) by the parameters from the reduced-form equations for W and Q (obtained by solving equations 1 and 2 for the endogenous variables, Q and W).[24] Assuming no change in the supply equation, falling machine-picking costs reduced the equilibrium wage by 2.95 percent annually (−4.1 × (−1/(−0.38 − 1.01))). The fourth column of numbers shows the resulting change in hand-harvested cotton due to a movement along the

Table 5 South: Average annual percent change in quantity of labor employed in hand harvesting, response to shifts in demand and supply

	Annual average percentage change				Percent of total change in labor predicted of actual[e]
	Change in variable[a]	Shift in function[b]	Change in wages[c]	Change in quantity of labor[d]	
Demand					
Real machine-harvesting costs	−4.00	−4.10	−2.95	−2.98	41
Real cotton price	−1.91	−2.40	−1.73	−1.74	24
Soil Bank dummy variable for years 1956–58, 1964 only[f]	—	−22.54	−16.28	−16.40	
Cotton yields	4.12	3.16	2.28	2.30	−32
Supply					
Real nonagricultural wages	1.64	−2.91	2.11	−0.79	11
Cotton yields	4.12	3.71	−2.68	1.01	−14[g]

[a]Annual rate of change estimated from regression equation: $\log(x) = a + rt + sd + e$.
[b]Shift in function is change in variable times estimated elasticity.
[c]Reduced form change in wages (due to variable) is shift in function times

$$\left[\frac{1}{\alpha_1 - \beta_1}\right].$$

[d]Change in employment is change in wages times wage elasticity (of supply or demand).
[e]Cotton harvest labor employment declined, on average, by 7.2 percent annually.
[f]Soil Bank represents a dummy variable and thus a shift in the function. This is not comparable to an annual average although the effect is large for the years in question.
[g]Negative sign denotes that this counteracts the decline in labor; that is, it is an increase.

supply or demand function. Cheaper machine costs meant that the equilibrium quantity of labor fell by 2.98 percent each year (−2.95 × 1.01). Thus, cheaper machine substitutes accounted for 41 percent of the 7.2 percent average annual decline in hand-harvested cotton employment in the South from 1949 to 1964.

In both regions, falling machine costs accounted for more than 30 percent of the annual average decrease in employment: 31 percent in the West and 41 percent in the South (tables 5 and 6). Western growers mechanized rapidly so that cheaper machine picking led to a decrease of over 5 percent

Table 6 West, including bracero effect on supply: Average annual percent change in quantity of labor employed in hand harvesting, response to shifts in demand and supply

	Annual average percentage change				Percent of total change in labor predicted of actual[e]
	Change in variable[a]	Shift in function[b]	Change in wages[c]	Change in quantity of labor[d]	
Demand					
Real machine-harvesting costs	−5.67	−7.84	−10.07	−5.55	31
Real cotton price	−1.90	0.53	0.67	0.37	−2
Soil Bank dummy variable for years 1956–58, 1964 only[f]	—	8.07	10.38	5.71	
Cotton yields	3.08	3.96	−5.09	2.81	−16[g]
Supply					
Real nonagricultural wages	1.94	−5.13	6.59	−1.50	8
Cotton yields	3.08	2.64	−3.29	0.77	−4[g]
Braceros selected years[h]					
1954–58	3.6	0.13	−0.17	0.04	−1
1959–64	−24.12	−0.89	1.14	−0.26	1

Notes: Supply and demand elasticity for this table were taken from Schuh and Leeds 1963 (supply = 0.551) and Tyrchniewicz and Schuh 1966 (demand = −0.227), for the Pacific region, because our estimated demand elasticity was positive. See text explanation.

[a]Annual rate of change estimated from regression equation: $\log(x) = a + rt + sd + e$.

[b]Shift in function is change in variable times estimated elasticity.

[c]Reduced form change in wages (due to variable) is shift in function times

$$\left[\frac{1}{\alpha_1 - \beta_1}\right].$$

[d]Change in employment is change in wages times wage elasticity (of supply or demand).

[e]Cotton harvest labor employment declined, on average, by 18 percent annually.

[f]Soil Bank represents a dummy variable and thus a shift in the function. This is not comparable to an annual average. Inclusion of Korean War dummy eliminates this effect.

[g]Negative sign denotes that this counteracts the decline in labor; that is, it is an increase.

[h]Braceros increased until the mid-1950s and decreased thereafter. The last column on the right is relative to the annual average in stated years. See text for details.

per year in the hand harvesting of cotton, a much faster decline than the 3 percent rate in the South (table 6). Nonetheless, the *relative* contribution of mechanization to the total fall in southern employment exceeded that in the West because the South experienced a smaller total average annual labor decline, 7.2 percent, compared with 18 percent in the West.

The other variables accounting for the change in hand-harvested cotton produced quite different results for the two regions. In the South, falling cotton prices accounted for 24 percent of the decrease in hand-harvested cotton (table 5). Although the uncertainty of cotton demand, and the South's reliance on this crop, had been a problem since the nineteenth and early twentieth centuries, cotton's relative profitability justified its major role in the southern economy.[25] After World War II, however, major dislocations resulted, especially due to the growth in synthetic fiber production. By contrast, our estimates reveal that cotton prices had little effect on western labor demand (table 6).[26] Why would prices, set in world markets, have such differential effects in the two regions? Higher western yields and more rapid mechanization led to a more favorable cost structure in that region. By contrast, many southern producers, except in the fertile Mississippi Delta and a few other localities, worked relatively poor land; price declines in such a setting could tip the balance toward negative returns to cotton.

Despite not being able to measure directly the effect of the Soil Bank program, we obtain suggestive results: labor demand in the South fell by 16 percent during the four years the program was in effect compared to other years, as measured by the dummy variable (table 5, fourth column under "annual average percentage change"). Although one cannot make a direct comparison due to the discontinuous nature of the Soil Bank effect, the annual decrease in hand-harvested cotton was −7.2 percent per year in the South. By contrast, the Soil Bank had no discernible effect in the West (table 6).

Rising wages outside of agriculture caused a decline in the workforce of more than 10 percent of the average annual decrease in the South. Clearly, the pull of better wages outside of agriculture mattered since, without their effect, our estimates indicate that harvest wages would have fallen by about 2 percent *per year* more than they did (table 5). Higher nonagricultural wage rates led to a minor decrease in hand-harvesting labor supply in the West of −1.5 percent per year, accounting for 8 percent of the actual annual average decline (table 6).[27]

Clearly the labor market dynamics differed substantially in the two re-

gions. Western workers apparently had more options, although nonagricultural wage rates provided a smaller measurable pull influence than in the South. In the West, wages within agriculture but outside of cotton harvesting were probably highly correlated with those within harvesting, indicating better local opportunities for workers to switch to a variety of alternative crops during the harvest season. Finally, the proximity of workers' nonagricultural opportunities enabled easier movement between occupations, without necessarily incurring a permanent, long distance move.

The Bracero Program represented a major difference between the West and the South and a way that western growers benefited from the public administration of the farm labor supply. Western harvest mechanization and bracero use increased simultaneously until the late 1950s, when bracero employment dwindled and spindle pickers became ubiquitous. Table 6 provides the relative shifts including braceros in the labor supply function. These estimates show that approximately until 1958, braceros offset the decline in hand harvesting due to mechanization, at about a ratio of +1 to −100 (see entry of −1 percent in far right-hand column, table 6).[28] During the period 1959–64, the exodus of braceros accounts for about 1 percent of the annual decrease in hand-harvested cotton.

The Soil Bank program history highlights the significant regional differences in factors contributing to the demise of hand-harvested cotton. Western growers actually increased output modestly during the years of this federal government program, in contrast with the severe negative effect on planted acreage in the South. With respect to the labor demand estimation, table 6 indicates that western labor demand was relatively higher in the years that the Soil Bank was in effect than otherwise (see also table 2, from which one can make a similar inference). It may also be the case, however, that the Korean War depressed labor demand in the West, making the Soil Bank years look high by comparison. If we control for the Korean War in the labor demand function, the Soil Bank years show an effect that appears to be much smaller (the coefficient is −2.2 percent and is not statistically significant).[29] It remains, however, that, unlike the South, westerners exhibited average or above-average labor demand during the Soil Bank years versus extremely depressed labor demand in the South, where growers sought a less risky alternative to cotton.[30] When offered government subsidies to divert acreage, southerners retired millions of acres formerly devoted to cotton, with a severe effect on the labor force. Although southern cotton acreage increased

after 1958 when the Soil Bank program was suspended, southern growers did not completely reverse their decrease in acreage (Heinicke 1997). In the West, more profitable cotton production allowed growers to stick with this valuable crop while rapidly mechanizing it.

Conclusion

The transition from hand to machine harvest of the U.S. cotton crop following World War II involved very different responses in the South and West to national changes in cotton prices and government programs to limit cotton acreage. Labor demand in both regions responded similarly, however, to the introduction of the mechanical cotton picker. Using newly reconstructed data, we have measured the effect of key variables on hand-harvested cotton from 1949 to 1964. Shifts in the demand for hand-harvested cotton were quantitatively more important than supply in both the South and the West. Contrary to the conclusions of previous empirical estimates, technological improvements in mechanical cotton harvesting were the most important factors in both regions. Only in the South, however, did government farm programs that reduced cotton acreage and falling cotton prices have a large effect on the labor force. On the harvest labor supply side, nonagricultural wages drew some workers from the harvest in both regions, with the South exhibiting a slightly larger effect.

This comparison illustrates how a region's historical setting provides a key to understanding its responses to changes in technology, competitive pressures, and government policies. At the beginning of our period, the South's cotton harvest labor market context included the legacy of slavery and the adaptation of the postbellum South to the region's particular natural environment. Cotton in the West emerged only in the 1930s, the labor force having been shaped by transplants from the American Midwest and the settlement of Mexican immigrants, which gave rise to a significant migrant labor stream. The West's environment highly favored cotton production. In the South, planters harvested their cotton with a combination of sharecroppers and tenants, resident plantation wage workers, and local day-haul labor. After World War II, due to poorer soils and environmental conditions less amenable to high-yield cotton production, southern growers sought more profitable uses for their resources. A quarter of the decline in hand-harvested cotton in the South resulted from falling cotton prices that induced growers

to divert acreage from marginal lands. Similarly, southern planters welcomed government Soil Bank payments for removing land from production, causing an extraordinary decrease in labor demand during its four years of operation, a markedly different response than that which occurred in the West. Better paying nonagricultural jobs drew workers from southern cotton fields and, by our estimates, accounted for about 11 percent of the decrease in hand-harvested cotton. For the South, these factors meant the demise of the cotton plantation and of the employment base that sustained much of the large rural population. Although now dominated by medium- and large-sized urban centers and new industries, significant pockets of southern rural poverty persist to this day.

In the West, by contrast with the South, falling prices and federal government incentives to take acreage out of production after World War II failed to reduce cotton output because producing the crop was more profitable there. Higher nonagricultural wages accounted for less than 10 percent of the decrease in hand-harvested cotton in the West. The small contribution of urban wages pulling workers from cotton production may well reflect the availability of other local agricultural opportunities as an alternative to cotton. Also, unlike the South, western growers temporarily solved their labor problems through a federal government program to bring in Mexican nationals (braceros) to meet the seasonal labor demand. American wages enticed Mexican workers to participate in large numbers.

Migrant workers became widely familiar to the public, having received international attention during the protracted United Farm Workers' organizing drive led by César Chávez. The use of Mexican guest workers, a key part of the western cotton harvest labor market, stimulated and complicated these organizing efforts (Gonzales 1999).[31] The Bracero Program forestalled mechanization until the mid-1950s, when it reached its peak; thereafter bracero costs and regulation increased and mechanization rapidly accelerated, putting an end to hand labor in cotton harvesting. While some domestic workers in the West withdrew from cotton for better local opportunities, those unprepared for higher paying occupations stayed in the migrant stream, bringing to market melons, lettuce, tomatoes, tree crops, and other agricultural products. These workers remain among the lowest paid workers in the country, without job security or benefits. The plight of migrant farmworkers remains largely unimproved today in part due to the temporary nature of the work.[32]

The demise of hand-harvested cotton in the post–World War II era thus resulted from very different western versus southern responses to federal government programs, changes in cotton prices, and the widespread diffusion of the mechanical cotton picker with substantial associated effects for racial and ethnic populations and for rural and urban labor markets.

Notes

For their helpful comments, we thank Bill Collins, Lee Alston, Eric Hilt, Larry Neal, Doug Holtz-Eakin, and the participants in the 2002 Social Science History Association meeting and the Harvard University Economic History workshop. Craig Heinicke can be reached at the Department of Economics, Baldwin-Wallace College, Berea, Ohio, 44017–2088; cheinick@bw.edu. Wayne A. Grove can be reached at Le Moyne College, 1419 Salt Springs Road, Reilly Hall, Syracuse, New York, 13214; grovewa@lemoyne.edu.

1 Cotton production was among the most labor-intensive of the major American crops in 1949 (U.S. Department of Commerce 1975: 500).

2 Our statistical analysis excludes the Southwest—Texas and Oklahoma—because growers in those states adopted mechanical strippers for which we have no cost data.

3 There were many causes of out-migration—a matter separate from, but closely related to, the decline of hand-harvested cotton (see Johnson and Campbell 1981; Heinicke 1994). Migration in turn was connected to the episodic nature of black progress (see Donahue and Heckman 1991) and changes in the black-white unemployment gap (Fairlie and Sundstrom 1999). A related matter is whether changes in technology throughout American history have been inimical to African American progress (Walton 1999).

4 Gavin Wright (1986, 1987) finds the South prior to World War II to comprise a separate labor market from other regions.

5 Although cotton prices were set in a world market, differing land quality implied the effect of declining prices varied by region.

6 Tennessee and Mississippi farmers near Memphis also employed day-haul workers (see Cunningham 1963; McWilliams 1944: 296–98). Day-haul workers were officially categorized as migrants if they crossed a state line, despite the proximity of traveling to an adjacent county.

7 Regarding cotton and migrant labor, see Weisiger 1995; Weber 1994; Coalson 1977; Foley 1997; and Sitton and Utley 1997.

8 Most debris was mixed in with the seed cotton during the harvest when field hands grabbed the leaves and stems of cotton plants or weeds along with the cotton bolls. Discoloration resulted from rapid microorganism growth and due to staining from green leaves. Mature cotton in the field could lose one grade in value with only a week's exposure to a combined relative humidity and temperature of at least 140 degrees (see Grove 2000).

9 The beginning of the harvest depended upon the timing of the killing frost. Hand-

harvest speed depended most importantly upon the size of the cotton boll (determined by the variety planted and the density of plants in the field) and the harvest method (instead of picking, growers could have workers pull the entire boll).

10 We view quality preservation as one more in a considerable list of functions provided by the tenant plantation along with spreading out production risks (Reid 1973), solving credit constraints (Wright 1986), and minimizing the transactions costs associated with labor turnover, monitoring, and supervision given worker attributes (Alston and Higgs 1982; Alston and Ferrie 1999).

11 In addition, grasses in southern fields proved difficult for gin extraction and caused mill stoppages (Sayre 1948: 140–45; Street 1957: 155); the broad-leafed plants of the West were more easily removed (Sayre 1948: 140–41).

12 We include the Southwest in the figure so that the total shares sum to 100 percent, but as noted, cost data are not available for the Southwest.

13 Long, dry harvest seasons allowed westerners to achieve much greater machine utilization rates than growers in the humid South (see Meier 1969). Regarding the lag in cotton mechanization, also see Whatley 1987.

14 Exceeding the allotment precluded growers from selling their crop to the federal government for a guaranteed minimum price.

15 See U.S. Department of Agriculture Commodity Stabilization Service 1959; Cable 1957. Under the acreage reserve provision of the program, farmers received an amount comparable to the net returns per acre in cotton to withdraw land from cotton (below that of allotted acreage).

16 Below average quality land may have meant lower returns than accepting the Soil Bank payment (Heinicke 1997).

17 We tested and rejected the hypothesis of a unit root at the 1 percent level for the dependent variable with or without deterministic trend. See Im et al. 1997 on this test with panel data.

18 A time series of custom rates is only available for Arizona (see Grove and Heinicke 2003).

19 Allotted acreage for the West in 1950 is not available. The values for allotted acreage in this year were set equal to planted acreage for these three observations, since allotment percentages of planted acreage for the next year in which allotments were in force (1954) were close or equal to 100 percent, unlike the case in most southern states.

20 For southerners, the primary destination state was regarded as state "y" where the change in "born in state x, living in state y" in the previous decade was the greatest, calculated from Eldridge and Kuznets 1964 (Grove and Heinicke 2003). For the West, California is used as the primary destination state. Wage expansion during the 1950s meant that the average wage in manufacturing would overstate the opportunity cost to those entering nonagricultural labor markets in the later part of our period (see Margo 1995; Maloney 1994).

21 An argument could be made that yields belong in only one function; we ran both versions.

22 Due to autocorrelation in the supply equation, the first stage estimates omitted Q_{t-1},

which should produce consistent and asymptotically efficient estimates (Greene 1997: 749).

23 These are short-run elasticities in the context of the partial adjustment model (see above and Nerlove 1958). Long-run elasticities could be obtained by dividing one minus the coefficient on Q_{t-1} into that of the coefficient in question.

24 Using these reduced-form equations, we compute the change in wages implied by a change in the exogenous variable of interest during our period. For instance, combining the two steps, the change in wages due to mechanization would be

$$\%\,\Delta\ in\ W = (-\alpha_3\,\%\,\Delta\ MCOST)\left(\frac{1}{\hat{\alpha}_1 - \hat{\beta}_1}\right).$$

25 For references on the South's reliance on cotton, see DeCanio 1974; Wright 1986.

26 Cotton prices have the opposite sign as expected in the western demand function, although the magnitude is close to zero. Correlation with the bracero variable may affect the results.

27 The results are not particularly sensitive to different labor demand elasticities from similar regions (we experimented with other regional elasticities from Schuh and Leeds 1963, with little resulting change).

28 In short, the Bracero Program slowed the pace of mechanization temporarily (Grove 2000, 1996; and figure 2).

29 If we control for the Korean War in the South, the effect of the Soil Bank becomes even more pronounced and negative (not reported).

30 Profitability was higher in the West than in the South (U.S. Department of Agriculture 1960, 1961).

31 César Chávez, who led the United Farm Workers, picked cotton in his youth (Weber 1994).

32 Recently, labor-intensive crop production in the United States has increased at a pace faster than that at which labor-saving machines have displaced them (Martin 1990).

References

Alston, Lee J., and Joseph P. Ferrie (1999) Southern Paternalism and the American Welfare State. Cambridge: Cambridge University Press.

Alston, Lee J., and Robert Higgs (1982) "Contractual mix in southern agriculture since the Civil War: Facts, hypotheses, and tests." Journal of Economic History 42: 327–53.

Arizona State Employment Service (1951) Arizona Cotton Harvest, 1950: A Study of Hand and Machine Picking of Cotton in Arizona. Phoenix: Employment Security Commission of Arizona.

——— (1960) Arizona Cotton Production Survey, 1959–1960. Phoenix: Employment Security Commission of Arizona.

Cable, C. Curtis, Jr. (1957) A Chronology of Government Programs for American Upland

Cotton. Bulletin No. 587. Fayetteville: Agricultural Experiment Station, College of Agriculture and Home Economics, University of Arkanasas.

Coalson, George O. (1977) The Development of the Migratory Farm Labor System in Texas: 1900–1954. San Francisco, CA: R and E Research Associates.

Cochrane, Willard Wesley, and Mary Ellen Ryan (1976) American Farm Policy, 1948–1973. Minneapolis: University of Minnesota Press.

Cunningham, Firman Lytle (1963) "An analysis of the development, operation, and economic significance of the farm labor market in Memphis, Tennessee." PhD diss., Vanderbilt University.

Daniel, Pete (1985) Breaking the Land: The Transformation of the Cotton, Tobacco, and Rice Culture since 1880. Urbana: University of Illinois Press.

Day, Richard (1967) "The economics of technological change and the demise of the sharecropper." American Economic Review 57: 427–49.

DeCanio, Stephen J. (1974) Agriculture in the Postbellum South: The Economics of Production and Supply. Cambridge, MA: MIT Press.

Donahue, John J., III, and James Heckman (1991) "Continuous versus episodic change: The impact of civil rights policy on the economic status of blacks." Journal of Economic Literature 29: 1603–43.

Eldridge, Hope T., and Simon S. Kuznets (1964) Population Redistribution and Economic Growth 1870–1950. Vol. 3, Demographic Analyses and Interrelations. Philadelphia, PA: American Philosophical Society.

Evans, Samuel Lee (1941) "Texas agriculture, 1880–1930." PhD diss., University of Texas.

Fairlie, Robert W., and William A. Sundstrom (1999) "The emergence, persistence, and recent widening of the racial unemployment gap." Industrial and Labor Relations Review 52: 252–70.

Fisher, Lloyd (1952) The Harvest Labor Market in California. Cambridge, MA: Harvard University Press.

Fite, Gilbert (1984) Cotton Fields No More: Southern Agriculture, 1865–1980. Lexington: University of Kentucky Press.

Foley, Neil (1997) The White Scourge: Mexicans, Blacks, and Poor Whites in Texas Cotton Culture. Berkeley: University of California Press.

Gonzales, Manuel (1999) Mexicanos: A History of Mexicans in the United States. Bloomington: University of Indiana Press.

Greene, William H. (1997) Econometric Analysis. 3rd ed. Upper Saddle River, NJ: Prentice Hall.

Grove, Wayne A. (1996) "The Mexican farm labor program, 1942–64: Government administered labor market insurance for farmers." Agricultural History 70: 302–20.

——— (2000) "The economics of cotton harvest mechanization in the United States, 1920–1970." PhD diss., University of Illinois Urbana-Champaign.

Grove, Wayne A., and Craig Heinicke (2003) "Better opportunities or worse? The demise of hand harvest labor and cotton, 1949–64." Journal of Economic History, 63: 736–67.

Heinicke, Craig (1994) "African American migration and mechanized cotton harvesting in the 1950s." Explorations in Economic History 31: 501–20.

——— (1997) "The Federal Soil Bank, the decline of cotton, and the demise of the southern plantation in the 1950s." Paper presented at the Cliometrics meetings of the Allied Social Sciences Association, New Orleans, January.

——— (1999) "Southern tenancy, machines, and production scale on the eve of the cotton picker's arrival." Social Science History 23: 435–58.

Holley, Donald (2000) The Second Great Emancipation: The Mechanical Cotton Picker, Black Migration, and How They Shaped the Modern South. Fayetteville: University of Arkansas Press.

Im, Kyung So, M. Hashem Pesaran, and Yongcheol Shin (1997) "Testing for unit roots in heterogeneous panels." Working paper, Department of Economics, Cambridge University.

Jacobson, Tim C., and George D. Smith (2001) Cotton's Renaissance: A Study in Market Innovation. New York: Cambridge University Press.

Johnson, Daniel M., and Rex R. Campbell (1981) Black Migration in America: A Social Demographic History. Durham, NC: Duke University Press.

Kirby, Jack Temple (1987) Rural Worlds Lost: The American South, 1920–1960. Baton Rouge: Louisiana State University Press.

Lindsey, Morris M., and Arthur M. Heagler (1967) "Cotton harvesting in the Yazoo-Mississippi Delta." Mississippi Agricultural Experiment Station Bulletin No. 739. May. State College: Mississippi Agricultural Experiment Station.

Maloney, Thomas (1994) "Wage compression and wage inequality between black and white males in the United States, 1940–60." Journal of Economic History 54: 358–81.

Margo, Robert A. (1995) "Explaining black-white wage convergence, 1940–50." Industrial and Labor Relations Review 48: 470–81.

Martin, Phillip L. (1990) "The outlook for agricultural labor in the 1990s." U.C. Davis Law Review 23: 499–523.

McDonagh, Edward C. (1955) Attitudes toward Ethnic Farm Workers in Coachella Valley. Sociology and Social Research No. 40. Reproduction.

McWilliams, Carey (1944) Ill Fares the Land: Migrants and Migratory Labor in the United States. Boston, MA: Little Brown and Company.

Meier, Frank (1969) "An economic analysis of adoption of the mechanical cotton picker." PhD diss., Department of Economics, University of Chicago.

Musoke, Moses, and Alan Olmstead (1982) "The rise of the cotton industry in California: A comparative perspective." Journal of Economic History 42: 385–412.

National Cotton Council of America (1947) Proceedings of the First Annual Cotton Mechanization Conference. Memphis, TN: National Cotton Council of America.

Nerlove, Marc (1958) The Dynamics of Supply: Estimation of Farmers' Response to Price. Baltimore, MD: Johns Hopkins Press.

Peterson, Willis, and Yoav Kislev (1986) "The cotton harvester in retrospect: Labor displacement or replacement?" Journal of Economic History 46: 199–216.

Reid, Joseph (1973) "Sharecropping as an understandable market response: The post-bellum South." Journal of Economic History 33: 106–30.

Sayre, Charles Richard, Jr. (1948) "The economics of mechanization in cotton production." PhD diss., Harvard University.

Schuh, G. Edward, and J. R. Leeds (1963) "A regional analysis of the demand for hired agricultural labor." Papers and Proceedings of the Regional Science Association 11: 295–308.

Sitton, Thad, and Dan K. Utley (1997) From Can to Can't See: Texas Cotton Farmers on the Southern Prairies. Austin: University of Texas Press.

Street, James (1957) The New Revolution in the Cotton Economy: Mechanization and Its Consequences. Chapel Hill: University of North Carolina Press.

Tyrchniewicz, Edward, and G. Edward Schuh (1966) "Regional supply of hired labor in agriculture." Journal of Farm Economics 48: 537–56.

U.S. Department of Agriculture (1947) "Preliminary survey of major areas requiring outside agricultural labor." Farm Labor Program, Extension Service, Extension Farm Labor Circular 38. Washington, DC: U.S. Government Printing Office.

——— (1960) "Farm costs and returns: Commercial farms by type, size, and location." Economic Research Service, Agricultural Information Bulletin 230. Washington, DC: U.S. Government Printing Office.

——— (1961) "Costs and returns on commercial farms: Long-term study, 1930–57." Economic Research Service, Statistical Bulletin No. 297. Washington, DC: U.S. Government Printing Office.

——— (1974) Statistics on Cotton and Related Data 1920–1973. Washington, DC: U.S. Government Printing Office.

———, Commodity Stabilization Service (1959) "Compilation of statutes relating to soil conservation, marketing quotas, Soil Bank, Commodity Credit Corporation, price support, export and surplus removal, crop insurance, sugar payments, marketing agreements and orders, and related statutes." Agricultural Handbook No. 158. January 1. Washington, DC: U.S. Government Printing Office.

U.S. Department of Commerce (1975) Historical Statistics of the United States, Colonial Times to 1970. Washington, DC: U.S. Government Printing Office.

U.S. Department of Labor, Bureau of Employment Security (1962) Cotton Harvest Mechanization: Effects on Seasonal Hired Labor. Washington, DC: U.S. Government Printing Office.

Walton, Anthony (1999) "Technology versus African-Americans." Atlantic Monthly, January.

Weber, Devra (1994) Dark Sweat, White Gold: California Farm Workers, Cotton, and the New Deal. Berkeley: University of California Press.

Weisiger, Marsha L. (1995) Land of Plenty: Oklahomans in the Cotton Fields of Arizona, 1933–1942. Norman: University of Oklahoma Press.

Whatley, Warren (1987) "Southern agrarian labor contracts as impediments to cotton mechanization." Journal of Economic History 46: 45–70.

——— (1991) "New estimates of the cost of harvesting cotton: 1949–1964." Research in Economic History 13: 199–225.

Williamson, Jeffrey G., and Peter H. Lindert (1980) American Inequality: A Macroeconomic History. New York: Academic.

Woofter, Thomas J., Gordon W. Blackwell, Harold C. Hoffsommer, James G. Maddox,

Jean M. Massell, B. O. Williams, and Waller Wynne (1936) Landlord and Tenant on the Cotton Plantation. Research Monograph No. 5. Washington, DC: Works Progress Administration.

Wright, Gavin (1986) Old South, New South: Revolutions in the Southern Economy since the Civil War. New York: Basic Books.

——— (1987) "The economic revolution in the American South." Journal of Economic Perspectives 1: 161–78.