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ABSTRACT

Agriculture dominated the economy of eighteenth-century British America, and the pace of agricultural productivity advance was the primary determinant of the rate of economic growth. In this paper we offer new measures of agricultural productivity advance in the Lower South between 1720 and 1800. Past efforts at quantification have focused exclusively on the region's export performance. In addition to extending and refining measures of regional exports, we develop two new series based on the value of slave labor and on measurements of total agricultural production in the region. Despite differences in their short-term behavior, all of the indices show that long-run productivity improvements were modest at best, and may have been negative. Surprisingly, taking account of production for domestic consumption yields the most favorable long-term performance.

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In eighteenth-century British America changes in per capita income were closely tied to movements in output per worker in agriculture. Over 74 percent of the U.S. labor force was employed in the farm sector in 1800, and the share was even higher in the preceding century.[1] Consequently the pace of improvement in agricultural productivity was the primary factor determining the rate of economic growth. Any effort to measure economic growth rates in this period rests either implicitly or explicitly on estimates of agricultural productivity. Because crops and agricultural practices varied considerably between regions, attempts to estimate the growth of productivity and income are best conducted at the regional, or even sub-regional, level.

In this paper we offer new measures of the rate of agricultural productivity advance during the eighteenth century in the Lower South—the region comprising what became the states of South Carolina, North Carolina, and Georgia. During this period, the Lower South developed a distinctive, export-oriented agricultural system heavily reliant on slave labor. Judged from the perspective of wealth accumulation among the free population, this system was remarkably successful in the colonial era.[2] In the past decade a burgeoning historical literature has painted an increasingly detailed picture of many aspects of this society.[3] Although these accounts offer considerable insight into the evolution of agricultural practices in the region, they provide little evidence about their quantitative impact on agricultural productivity and hence on the standard of living.

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[1] The 1800 share is from Weiss (1992, p. 22). Lebergott (1984, p.66) and David (1967, Appendix Table 1) put the 1800 figure as high as 83 percent. Mancall and Weiss (1999) put the share around 78 percent a century earlier.

[2] See Jones (1980), Coclanis (1989, p. 125), and Morgan (1998). Much of this success, however, reflects the rapid growth of the slave population in the region. When calculated for the entire population, free and slave, non-human wealth per capita in the Lower South did not differ appreciably from that in other regions.

To date efforts at quantification have been confined primarily to measures based on the region's export performance, with scholars having examined trends in exports per capita and per slave over the colonial period (Coclanis 1989, pp. 76-78; Nash 1992). Such information is useful—and we refine and extend these measures below—but it is important to bear in mind that exports constituted only about twenty to twenty-five percent of the value of regional agricultural production.[4]

In an effort to capture the effects of changes in agricultural productivity outside the export sector, we explore two new bodies of evidence in this paper. The first new body of evidence is a time series on the value of slave labor. Masters employed slaves primarily to produce export crops, and the value of the exports they produced was undoubtedly an important influence on the price of slaves. Slaves also produced most of the food that they and their owners consumed, and any changes that reduced the costs of providing their subsistence or increased the amount of food they could provide their masters would have increased their net earnings and hence their value. As a result, the slave price series should reflect a broader set of influences including advances in the production of domestically consumed agricultural goods.

Second we present estimates of total agricultural production in the region. We cannot directly observe agricultural production, but it is possible to estimate trends in total output using information on the likely levels of food consumption at different dates in conjunction with evidence on net exports from the region to foreign destinations as well as to other North American colonies.

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[3] Among recent historical studies, see Chaplin (1993), Coclanis (1989), Clifton (1981), Morgan (1998). Gray's (1958) study, although much earlier, still remains relevant.

[4] Although production for domestic consumption has not been measured directly it can be inferred, as we describe in greater detail below, on the basis of evidence about likely levels of consumption taken in conjunction with data on regional imports and exports. No plausible set of assumptions about the value of colonial food consumption would radically alter the export shares cited in the text.

As can be seen in Figure 1, the various indices depict somewhat different pictures of productivity change between 1720 and 1800. Both exports per slave and slave values rose sharply in the third quarter of the century, and then collapsed as a result of the loss of export markets during the Revolutionary War. Although these measures began to recover in the 1790s, reflecting the emergence of cotton as an important cash crop after 1793, both were still lower in 1800 than they had been in 1720.[5] In contrast, the broader measure of productivity, which takes account of domestically consumed food crops, dampens substantially the effects of these short-run swings in export performance—holding down productivity growth between 1750 and 1770, but bolstering it in the last quarter of the century.

Despite these differences in their short-term behavior, all of the indices show that over the long term productivity improvements were modest at best, and may have been negative. The annual rate of advance between 1720 and 1800 fell in a range between minus 0.2 and plus 0.3 percent per year. Surprisingly, it is the broader measure of productivity growth that yields the most favorable long term performance, and makes clear the need to better understand the portion of the agricultural sector that was producing for the domestic market.

1. An Overview of Agriculture in the Lower South

Contemporary observers recognized the centrality of agriculture to the economy of the Lower South and produced a large literature describing cultivation techniques and yields. For the most part, they confined their attention to the region's main export staples—rice, and indigo—but provide fewer details about other exports. In addition, accounts of cotton production are full and informative, but of course that crop was not prominent until near the close of the period. Much less is known about the livestock industries or about production of

[5] Even in the low country which was less suitable to the short-staple variety, cotton became an important

food crops. The available documents, while strong on description, are sparse on empirical evidence related to output and productivity. And, as we show below, the quantitative evidence found in these narrative histories and documents are at odds with the statistical evidence we can now bring to bear.

The contemporary accounts also focused predominantly on South Carolina, and rightly so because for most of the eighteenth century that colony dominated regional exports, as is evident in Figure 2. Although North Carolina was founded at about the same time as South Carolina, and was the most populous colony in the region, it did not develop a substantial export trade during the colonial period. Colonists in North Carolina produced naval stores and rice in and around the Cape Fear region (see Egnal 1998, ch. 6) and small amounts of tobacco in the Albemarle region near Virginia (Merrens, 1964, 120-24), but the lack of good internal transportation and the absence of good ports inhibited its making much of a contribution to regional exports. As Figure 2 shows, its share of the region's exports remained below10 percent in the eighteenth century except for a brief time in the early 1790s.

In contrast to its neighbors to the north, Georgia was not settled until the 1730s, and its population grew slowly at first, constrained by its founders' efforts to prohibit slavery. After colonial officials lifted the prohibition on slavery the colony's contribution to exports expanded as rice producers established plantations in lowland areas. Georgia's share of the region's exports began to increase in the late 1750s (see Figure 2), but except for a few years during the Revolutionary War, its share did not rise above 20 percent until the early nineteenth century.

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crop in the nineteenth century (Coclanis, 1989, p. 118).

Rice

Rice cultivation began in South Carolina in the late seventeenth century when would-be planters encouraged their African slaves to adapt West African agricultural practices to the local environment (Wood 1974, pp. 56-62). Although initially planters saw rice as an adjunct to the livestock industry, it quickly became South Carolina's—and the region's—dominant export crop.[6] In the 1720s, the value of rice exports was already twice that of naval stores, the next leading export, and by the end of the colonial period it had grown to account for 56 percent of regional export earnings (Egnal 1998, p. 101).

Given the important place of rice exports in the regional economy, it is not surprising that the crop elicited considerable contemporary discussion. These observations point to significant changes in the techniques of rice cultivation over the course of the eighteenth century, as various historians have described.[7] From the beginning of the century to about 1720, planters grew rice mainly in upland areas where they relied on rainfall to provide irrigation. The South Carolina climate was favorable to rice production, but harvests were small and unpredictable in this period. By the 1720s, planters had shifted their crop to swampy land in the low country, where they could better control irrigation by damming freshwater streams and ponds to create reservoirs. But uneven rainfall still created problems since excessive rains could flood fields, while droughts might result in too little water.

Planters could gain even greater control over irrigation by harnessing tide-induced changes in river levels. The exact date when this method was first used is not known, although it

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[6] Clifton (1981, p. 275) quotes Thomas Nairne who wrote in 1710 that because rice thrived "best in low moist Lands, it inclines People to improve that Sort of Ground, which being planted a few years with Rice, and then laid by, turns to the best Pasturage."

[7] This is a fairly standard story that can be found in recent histories by Peter Coclanis (1989), Peter Wood (1974), Philip Morgan (1998), and Joyce Chaplin (1993), as well in earlier works such as those by Gray (1958) and Clifton (1981).

may have been as early as the 1730s (Clifton, 1981, p. 275). Nevertheless, adoption of tidal irrigation proceeded slowly, perhaps because of the large sunk costs planters had invested in existing irrigation systems. Whatever the cause, most planters did not shift to this newer method until after the Revolution.[8]

Rice production was a labor-intensive process, requiring a substantial year-round labor force. The peak labor demands occurred during June and July, when the crop was cultivated, and late September and October when it was harvested. These peak periods of labor demand put a binding constraint on how much rice planters could produce (Morgan 1998, pp. 149-53). Improvements in irrigation, and especially the introduction of tidal irrigation helped to reduce peak labor demand, because regular flooding of fields reduced the growth of weeds while enabling planters to complete drain fields when weeding was necessary (Morgan 1998, p. 156). After 1750, planters also sought ways to reduce labor requirements by mechanizing the post-harvest processing of rice. Horse-driven pounding mills, which began to appear in estate inventories in the mid-1750s (Morgan, 1998, p. 155), could process as much rice in one day as sixteen slaves. There is no evidence, however, to indicate widespread use of these innovations and in the view of James Clifton (1982, p. 298) the machines were not successful.

Although eighteenth-century observers have left us with a number of descriptions of the methods employed in rice growing at different dates, and historians have constructed useful narratives about the various developments that took place, there is very little quantitative information about the impact of these changes on yields or on output per worker. As recently as 1985 John McCusker and Russell Menard (1985, p. 178) argued that "these innovations ... resulted in impressive productivity gains" and urged further study of the industry because it

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[8] For descriptions of these changes in technique see Chaplin (1992); Gray (1958, pp. 279-80); Clifton (1981); Dethloff (1982, p. 238); Egnal (1998, pp. 103-4); Morgan (1998, pp. 155-57).

would likely "pose another serious challenge to the conventional wisdom that colonial agriculture achieved little in the way of productivity gains."

Peter Coclanis (1989), Joyce Chaplin (1993) and Philip Morgan (1998) have since examined the evidence available and the consensus appears to be that yields rose from around 600 to 1,000 pounds of clean rice per acre in the early eighteenth century to about 1,500 pounds by the time of the American Revolution, while output per worker showed even more impressive gains. Output per worker rose in part because the yield per acre increased, but also because each slave could tend more acres under the tidal method of irrigation. In the middle of the century, slaves were likely to have tended 3 acres of rice, while after the Revolution slaves on tidal swamp plantations could have worked 5 acres.[9] It is conceivable that the number was even smaller before 1720 when rice was grown on inland plantations.[10]

Governor James Glen provides the chief, and perhaps the firmest, bit of evidence on output per worker in the middle of the century. According to Glen: "the common Computation throughout the Province, *communibus Annis*; which is, that each good working Hand employed in a Rice-Plantation make Four Barrels and Half of rice, each Barrel weighing Five Hundred Pounds Weight neat."[11] The figure may have been nearly that high in the early decades of the century (Whitten, 1982, p. 15), although Nairne's description would put the figure at only 1,500 lbs around 1710. Nevertheless, it would appear that most of the increases took place after mid-century and most likely as production shifted to tidal plantations largely after the Revolution. Peter Coclanis (1989, p. 97) surveyed a number of sources and concluded that "the figure for an

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[9] The mid-century figure is from Glen (1749 [reprinted in Milling 1951, p. 16]); the post-Revolutionary figure is from Clifton (1981, p. 277).

[10] Nairne ([1710], reprinted in Greene, 1989, p. 65) describes an estate on which 30 slaves would have planted 45 acres of rice, or 1.5 acres apiece. He is, however, describing the first year or so of operation, and the number of acres tended per slave likely increased as more acreage was cleared.

[11] Glen made his original report in 1749. It was published in 1761and reprinted in Milling, (1951, p. 16)

average hand had apparently grown to about 3000 to 3600 pounds yearly during the second half of the eighteenth century."

Taking these figures at face value implies a 50 percent increase in output per acre, and an increase of between 33 and 60 percent in output per worker. As we show below, the favorable view of productivity advances suggested by contemporary commentaries seems likely to overstate the true magnitude of the advances that occurred. Moreover, rice growing seems to be the one industry in which techniques changed enough to suggest that productivity must have advanced, so the picture for this industry is not likely to be representative of what was happening generally throughout agriculture.

Indigo and Cotton

In the 1740s, South Carolina planters added indigo to their list of cash crops. Indigo quickly emerged as the colony's and the Lower South's second leading export, a position it maintained until the 1790s, when planters substituted cotton for indigo throughout the interior areas of the region. The initial impetus for indigo cultivation came from the depressed conditions in the market for rice caused by the international conflict known as the War of Jenkins Ear which began in 1739 and pitted Britain against Spain in a contest for who would control shipping from the Caribbean through Central America. This conflict, as well as King George's War (1744-48), substantially raised shipping and insurance costs and caused a sharp drop in the prices received by rice farmers. Because indigo had a much higher value relative to weight than did rice, it could much more easily bear these costs than could a bulky commodity like rice. But the volume of exports did not take off until Britain began to offer a bounty for indigo in 1749. Prompted by these economic incentives planters increased the volume of indigo exports by more than eight-fold between 1750 and 1760 (see Table 2).

Indigo made a good companion to rice since its growing season was relatively short and the labor demands need not have competed with those of rice production. Planters sowed indigo in April and harvested the crop once in early July and they could make a second cutting in late August or early September.[12] Some planters in inland areas that were not well suited to rice cultivation specialized in indigo and would have tried to make two, or possible three, cuttings. Not so rice planters because only the first cutting would typically have taken place during a period of relatively slack labor demand in rice cultivation. Nevertheless, by restricting production to the first cutting, planters could have combined the cultivation of both rice and indigo. Once the crop was harvested, it had to be processed carefully and quickly. As a result the indigo crop-cycle was completed by the end of October, when rice beating began. Although the production of indigo could be integrated with that of rice, it nevertheless came at the expense of other things, most notably the production of naval stores.[13]

The equipment necessary to process indigo represented a significant capital outlay, but since indigo could be grown on a much smaller scale than rice, less wealthy planters had an opportunity to enter into export production. Despite its apparent advantages, however, indigo cultivation did not become popular. Indigo processing equipment was recorded in just 3.1 percent of probate inventories from the 1740s This figure was somewhat higher between the 1750s and the 1780s, but displayed no long run trend, varying from 5.3 percent of inventories in the 1750s, to 4.4 percent in the 1760s, 5.6 percent in the 1770s, and 4.5 percent in the 1780s

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[12] On rare occasions a third cutting could be made later in the fall (Morgan 1998, pp. 160-62).

[13] Contemporary accounts summarized in Gray (1958, pp. 296-97) suggest that on plantations where both crops were grown, each hand could cultivate 2 acres of indigo, one acre of rice, and enough food to provide his or her own provisions. Those indigo producers who chose not to plant rice would have employed their hands making naval stores, or cutting lumber, shingles, and staves.

(Chaplin 1993, p. 208-09).[14] Indigo cultivation was more important in the backcountry, however, where indigo vats were listed in 11 percent of inventories between 1750 and 1800 (Johnson 1997, p. 44).

In the low country, indigo replaced naval stores as the primary employer of slave labor outside of rice production. Because indigo could also be grown in mid- and up-country regions, and could be produced on a relatively modest scale, however, it provided the basis for the expansion of commercial agriculture into interior regions not suited to rice. Because the time requirements for the crop were limited, slaves on indigo plantations outside the low country probably spent almost half the year on growing provisions, rearing stock, and producing naval stores (Morgan 1998, p. 163). Although the introduction of indigo facilitated the expansion of settlement into interior regions of South Carolina, there was relatively little indigo cultivated in other parts of the region.[15] Although British bounties encouraging indigo were terminated with American independence, planters continued to grow the crop into the early 1790s.

In contrast to rice, there is little indication that techniques of making indigo changed over the course of the century. This is consistent with scattered evidence on output per worker gathered by Chaplin (1993, p. 203) from published sources and farm accounts. These data, summarized in Table 1, indicate that there was no clear trend in indigo production per worker.

After the invention of the cotton gin in 1793, farmers in the interior quickly shifted from indigo cultivation to growing cotton. Strong demand for cotton also encouraged coastal planters to replace indigo with cotton in the low country.[16] Because cotton was introduced only near the

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[14] Reflecting the decline of indigo production in the 1790s, Chaplin found no records of indigo processing equipment in probate inventories from that decade.

[15] According to the U.S. Bureau of the Census (1975, Series Z432-Z435), Georgia's exports of indigo accounted for just 3 or 4 percent of the regional total in most years.

[16] The shift to cotton was not entirely unexpected since low country planters had grown Sea Island cotton in small quantities before the 1790s. But large-scale cultivation of cotton began only in the early 1790s

end of the century, changes in technique cannot have been a factor in agricultural productivity change before 1800. But the shift from indigo to cotton may have contributed to an increase in output per worker, if—as appears likely—cotton was a higher value crop.

Naval Stores

In addition to rice and indigo, planters and slaves in the Lower South also produced a number of minor export crops, several of which were important early in the century, but contributed a diminishing portion of regional exports once rice and indigo became established. Of these the most important were tar, pitch, and turpentine. Production of these naval stores received considerable encouragement at the beginning of the century as a result of Parliamentary bounties, and the colonists were quick to respond. By the early 1720s, South Carolina planters and merchants exported well over 35,000 barrels of tar and pitch per year, contributing about half as much to the colony's export earnings as its shipments of rice. Labor costs were a major barrier, and efforts to economize on labor inputs contributed to the low quality of the region's products. When British bounties were removed in 1724 production and exports plummeted. There is little evidence that would suggest that techniques of production changed much over the century, and after the 1720s naval stores contributed a diminishing share of the region's exports, produced primarily in interior areas where farmers could not produce rice or indigo (Gray 1958, pp. 156-57; Egnal 1998, p. 111).

Livestock and Food Crops

Despite the importance of export staples in the region's economy, they represented only a small fraction of total agricultural production. The production of food crops and livestock

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with the introduction of short-staple varieties that grew well in interior regions (Gray 1958, p. 683;

products made up the bulk of the agricultural sector throughout the entire colonial period. Indeed, early on it was easier to develop the livestock trade than to produce staple crops for export, even though this was not what the Proprietors had in mind.[17]

South Carolina had become an important herding region by the 1680s because cattle, hogs and sheep could be raised at little expense, with only sheep requiring any labor input (Gray, 1958, p. 56). In 1710 Thomas Nairne described an abundance of cattle and hogs, which "have mightily increas'd since the first settling of the Colony," and which were raised with little or no labor input—"whereby the Planters are freed from the Trouble of providing for them…"[18] Livestock products were among the early exports from South Carolina and remained of some importance until the settlers developed other staple crops. Livestock exports probably reached their peak of importance from 1705 to 1715 (Clowse, 1971, p.178). In a period of 12 months in 1712-13, the colony exported 1,241 barrels of pork and 1,963 barrels of beef (Clowse, 1971, p. 257-59, Appendix Table III), in all amounting to about 600,000 pounds of meat.[19] Thereafter, the annual shipments abroad fell off, perhaps because of the destruction of the stock during the Yamasee War of 1715-16, but also because rice became a profitable export. From 1717 to 1720, exports of beef and pork averaged only 1,050 barrels per year and declined further during the 1730s (Clowse, 1971, Appendix Table III). The value of beef and pork exports increased somewhat thereafter, totaling £6,125 in 1747-48, and averaged £12,564 from 1768 to 1772

Chaplin 1993, p. 305).

[17] Gray (1958, p. 55) quotes the Proprietors as "declaring that they 'intended to introduce planters and not graziers.'"

[18] Nairne, ([1710] as reprinted in 1989, p. 41). He described as well the presence of sheep and goats, and the availability of numerous tame and wild fowl along with wild beasts.

[19] Clowse (1971, p. 179) claims that a barrel of beef or pork sold for £2 to £3, which puts the value of these exports around £9,000 current money.

(Shepherd and Walton, 1972, Appendix IV, Tables 2-6). [20] Nonetheless beef and pork exports contributed only 3.8 percent of South Carolina's exports in 1747-48 and 2.2 percent in 1768-72.

Despite its limited contribution to exports, livestock raising expanded to meet the growing domestic demand. The growth of the plantation economy in South Carolina meant that planters needed low country lands previously used for livestock, prompting the relocation of herds, which moved first to Georgia and then into the up-country between the upper Ogeechee and the Savannah, where, in 1776, large cattle ranches with herds ranging from 1,500 to 5,000 or 6,000 head could be found (Gray, 1958, p. 149). The products of these cattle ranches were destined predominantly in the domestic market. Herders drove some cattle to Baltimore, Philadelphia and New York (Gray, 1958, p. 149), but the majority supplied provisions for residents of the Lower South.

We can only speculate about productivity changes in cattle raising. The shift toward larger scale ranches may have contributed to some economies of scale. But the corresponding shift from untended foraging to herding seems likely to have entailed additional labor inputs. The net impact of these forces remains to be determined.

The production of other food crops followed a pattern similar to that for livestock. Farmers in the lower South exported small amounts of corn and flour and other provisions throughout the colonial period, but their relative importance probably peaked early in the century (Clowse, 1971, Appendix Table III). In 1747 the export of Indian corn, barley, peas, and potatoes amounted to only 2 percent of the total value of exports (Coclanis 1989, p. 80-81), while in 1768-72 grain products equaled 2.2 percent of exports (Shepherd and Walton, 1972,

[20] Coclanis (1989, p. 80) reported exports of beef, pork and bacon as £42,881 S.C. currency, and we have converted at a rate of £7 pounds SC currency per pound Sterling.

Appendix IV, Tables 2-6). The vast bulk of food products were destined for domestic consumption.

Despite the fact that the vast majority of agricultural labor must have been devoted to the production of domestically consumed food crops, there is relatively little information about cultivation techniques, yields, or output per worker to be found either in contemporary or historical discussions of the region. Most of the available evidence is concerned with corn—the major staple in southern diets—and although Philip Morgan presents a very favorable picture of advances in output per worker, the more abundant narrative evidence suggests that productivity advance in this sector was limited at best.[21]

Early colonists adopted local Indians' methods of cultivation, intercropping corn with beans, peas, and pumpkins, and relying extensively on the hoe (Gray, 1958, p. 173). Yields per acre varied substantially, but it seems unlikely there was much, if any, improvement in yields over time. It is possible that corn yields were above 30 bushels per acre in the middle of the eighteenth century. Johan Martin Bolzius, for example, reported that around 1750 corn yields were 25 bushels per acre, plus beans, and a large number of pumpkins, melons, and cucumbers (Bolzius 1749; reprinted 1957, p. 257). One of the first settlers in Georgia wrote that "an acre of hickory ground near Savannah, of which there is plenty, generally produces 25 or 30 bushels of Indian corn; and at Augusta-town...an acre produces 35 bushels." (Force 1947 II, no. 12, p.4) Merrens (1964, 110) reports figures as high as 80 bushels per acre for North Carolina.[22] All of

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[21] Based on inventories of estates probated during the winter months, Morgan (1998, p. 48) concluded that "In South Carolina the average amount of corn produced by an adult slave was 17 bushels in the 1730s, 20 bushels in the 1750s, and 22 bushels in the 1770s." These increases imply that corn output per worker was increasing at 0.66 percent per year, which as we argue below is hard to explain unless it reflects a shift towards corn production at the expense of some other farm products.

[22] Merrens (1964, 110) claims "Only three estimates of corn yields in colonial North Carolina are known to exist." One of those put the yield at 80 bushels in southeastern North Carolina in the 1730s, while another estimate was "sixty to seventy bushels per acre, and sometimes as much as eighty to one hundred bushels."

these figures are likely too high to be typical. On the one hand, the writers may have been trying to make a favorable case for the attractiveness of settling in the region. More importantly, these yields most likely reflect the relatively high fertility of newly cleared lands, not the yields found on older farms.[23] Merrens (1964, p. 110) argued that a figure of 20 bushels per acre reported by the Moravians "is the most reliable guide to average yield during the 1760s and 1770s."

That yields declined over time appears all the more likely if we compare these colonial yields with those for the nineteenth century. Gray (1958, p. 909) argued that in eastern North Carolina, "year after year the nearly exhausted fields were scratched with light trowel or shovel plows to obtain yields of 6 to 12 bushels of corn and 4 to 8 of wheat." According to Parker and Klein (1966, p. 542, Table 10) the average yield for the entire South in 1839 was 12 bushels of corn per acre. For the eastern cotton states of the South, which included the states of the Lower South, the 1839 yield was 11 bushels, and showed no increase over the next 60 years (Gray 1958, p. 544, Table 12).[24] An average yield of around 11 bushels in the mid-nineteenth century (or 6 to 12 bushels in the early nineteenth century) is well below the 20 bushel per acre figure reported by Merrens for the late eighteenth century. Based on this evidence, it appears that yields declined in the century after 1740, reflecting most likely the fact that the newly cleared lands with higher fertility constituted a declining share of land under cultivation.

If yields per acre had held steady over the eighteenth century, improvements in labor productivity could have arisen only if each worker farmed more acres. But there is little evidence to suggests that farmers increased the number of acres worked per person. According

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[23] According to Gray (1958, 909) it was common to cultivate corn in the same fields continuously, thus reducing soil fertility. On the other hand, Hector Beringer de Beaufain, an early settler in Purrysburg, South Carolina claimed that corn fields were commonly planted for only four years (Coleman, 1959, p. 198).

[24] Atack and Bateman (1987, p. 172, Table 10.5) did not report yields for the South, only for the Northeast and Midwest. Their estimates for the Northeast, which seems like the more appropriate region

to Bolzius's report, around the middle of the eighteenth century each slave could cultivate as many as 4 acres devoted to provision crops in addition to 3 acres of rice each year. For the early nineteenth century planters Gray (1958, p. 708) assumed that each slave could cultivate about 5-6 acres of corn planted on clear level ground, suggesting the possibility of some improvement in this dimension of productivity. But Gray is silent about whether this figure applies to farms on which corn was the primary crop or is for those more specialized in the production of rice or cotton. Without such information it is difficulty to know whether the increase in acreage reflects a rise in labor productivity, or is the consequence of increased specialization.

With yields per acre on the decline and acreage cultivated per worker increasingly modestly at best, it is unlikely that there was much, if any, advance in output per worker in the production of food crops. An examination of the sources of productivity advance in corn production in the nineteenth century confirms this finding. In the nineteenth century output per worker in corn production in the South increased at the robust rate of 1.9 percent per year between 1839 and 1909, but this was a period in which the regional shifts of production pushed up yields per acre and, even more importantly, a period in which mechanization was at the forefront of agricultural developments.[25] In particular, the significant gains in corn output per worker in the South that occurred between 1839 and 1909 resulted specifically from the "abandonment of hoe cultivation." (Parker and Klein, 1966, p. 544). Neither regional shifts in production, nor the abandonment of the hoe could have had much of an effect on output per

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to use for comparison because the Midwest yields were influenced by production on newer lands, ranged from 3.4 bushels per acre in Connecticut to 18.2 in Pennsylvania.

[25] Calculated from data in Parker and Klein (1966, Table 1).

worker in the eighteenth century.[26] More generally, it is hard to identify any forces that could have pushed up productivity in corn production during the eighteenth century.

2. Export-Based Productivity Growth

International trade is one of the best-documented aspects of the eighteenth-century economy, and it is not surprising that scholars have attempted to use data on exports to gauge progress in agricultural productivity before 1776. Coclanis (1989, pp. 73-78), for example, used the quantity of rice exported per person and per slave to trace changes in productivity. He found that for South Carolina as a whole exports per capita or per slave showed no clear trend after the 1720s. But as he pointed out, most exports originated in the low-country, and relative to the population of this region, rice exports per capita and per slave did grow gradually from 1750 until the early 1770s. Because exports from South Carolina were dominated by rice, this evidence suggests that there had been some productivity improvements in rice production at least after 1750.

Productivity would also have been influenced by changes in the mix of crops other than rice produced: whenever planters reallocated labor to a higher valued crop, such as indigo, the aggregate output per worker would have risen. In an attempt to account for that effect, Nash (1992) constructed what he termed a "volume index" of South Carolina exports from 1710 to 1770 in which he aggregated exports of rice, naval stores, and indigo. In effect Nash constructed a constant price measure of exports expressed in physical units of production, by converting the quantities of indigo and naval stores exported into quantities of rice of equivalent value. Nash then divided the volume index by the total slave population in South Carolina to produce a

[26] If we were to eliminate the effects of these two sources of productivity from the calculation for 1839-1909 to produce a hypothetical rate of advance based on conditions more like those that prevailed in

measure of labor productivity. The resulting series shows that exports per slave rose rapidly in the period from 1710 to 1720 and again from 1750 to 1770.[27]

We have extended Nash's volume index forward from 1770 to 1800 based on exports of rice, indigo, and cotton, and refined the measure of labor input by adjusting the slave workers series to take account of changes in the age structure and location of the slave population.[28] To measure slave labor inputs in agriculture we first subtracted slaves living in Charleston—and thus unlikely to be engaged in the production of export crops.[29] Then we applied age and sex specific labor force participation rates to the remaining population. We assumed that the participation rate for slaves aged 10 and over, whether male or female, was 90 percent, while we excluded those under the age of 10 because they were unlikely to be in the labor force.[30] Because the number of children in the slave population increased over time, this adjustment causes the slave labor force to grow more slowly than the overall population, and raises the rate of growth of exports per worker.

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colonial times, there would have been no advance.

[27] In the text of his article Nash states that exports per worker rose from 1710 to 1730, but in fact the data in Table 6 of his paper show that exports per worker leveled off after 1720 and did not grow again until after 1750.

[28] To reflect shifts in relative prices after the Revolution, we converted exports of indigo and cotton to their equivalent volume of rice using post-1780 price data only, and used changes in the index between 1770 and later dates to extrapolate the level of exports in 1770 derived from Nash's series. We have not included naval stores in our calculation for the post-1770 period, but this is of little consequence. Although naval stores were an important component of South Carolina's exports early in the century, by 1770 they constituted only about 1.25 percent of the value of exports.

[29] Morgan (1984, Tables 4 and 5) shows no male or female slaves living in Charleston as holding farm occupations in the period 1730 to 1799.

[30] According to Morgan (1998, p. 197) "although the age at which a child entered the labor force varied from plantation to plantation, most masters in both Chesapeake and low country regarded the years of nine or ten as marking this threshold." To be consistent with the estimates of the labor force for the nineteenth century we have taken the threshold to be age 10. The participation rates as well are the same as those used in constructing estimates of the labor force for the nineteenth century (Lebergott, 1966 and Weiss, 1992).

Table 2 summarizes our revisions and extensions of the volume index.[31] From 1720 through 1750 there was no appreciable increase in exports per worker, but from 1750 to 1770 this ratio increased by nearly 50 percent, with almost all of the increase occurring by 1760.[32] This rapid increase was attributable almost entirely to the expansion of indigo exports after 1750, which occurred without any reduction in the production of rice per hand. But the rising trend of exports per worker was short lived since the Revolutionary War cut off most exports from the mid-1770s to the early 1780s. The loss of British markets, combined with the effects of the war on agricultural production in the Low country, reduced export volumes per hand by nearly 30 percent from 1770 to 1790. Though indigo exports remained relatively high in the 1780s despite the loss of British bounties, production of the crop essentially vanished after 1790 when planters shifted their efforts to cotton production. By the close of the century the rapid expansion of cotton exports had helped restore the volume of exports per worker nearly to its level in 1720.

The correlation between the introduction of indigo and the rapid growth of exports per worker suggests that the introduction of this crop was the major avenue of productivity advance in the eighteenth century. To the extent that indigo cultivation utilized underemployed resources this increase can be viewed as a true increase in productivity. But changes in this one export are likely a biased measure of productivity advance for all of agriculture because some of the increase came at the expense of other (unmeasured) production, such as domestically consumed food crops. Thus changes in exports per worker would be an upwardly biased measure of productivity advance for all of agriculture after 1750. By the same token, it seems likely that the

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[31] We have produced a similar index covering exports from the entire Lower South region, which shows similar changes over the colonial period. Given that similarity, we have shown only the index for South Carolina because it is more appropriate for comparison with the productivity series based on the value of slaves.

[32] Although export data can be extended back to 1710, we have begun our series in 1720 to be consistent in coverage with the other series we present in this paper.

post-1770 decline in exports per worker overstates the decline in per worker production by failing to take account of the increased production of farm goods destined for domestic consumption.

3. The Value of Slave Labor

As the foregoing discussion suggests, exports per worker may be a misleading index of agricultural productivity because exports were only a fraction of total agricultural production. Slave prices offer an alternative and potentially more inclusive measure of labor productivity in agriculture. In a competitive market, the (real) price of a slave will be equal to the expected value of the slaves stream of future production net of maintenance costs. Thus changes in the productivity of slaves in producing both exports and food needed for their own or their masters' consumption should be reflected in changes in slave prices. [33]

Using data from probate inventories we have constructed an annual time series of the prices of adult male slaves beginning in 1722 and extending into the nineteenth century (Mancall, Rosenbloom, and Weiss 2001). Table 3 reports 5-year averages of nominal slave prices and of an export price index from the early 1720s through 1805, as well as the real price of slaves obtained by deflating nominal prices by the export price index. The timing of movement

[33] Because the value of slave labor depended on both current and futures values of production and consumption, changes in the length of the stream of expected future net income—through changes in life expectancy—or changes in the rate of discount used to evaluate future income streams would also have influenced slave prices. We cannot measure the effects of these changes, but it seems clear that their effect, if any, would have been to push up slave prices over the period 1720 to 1800, which means this measure of labor productivity is likely to overstate the true rate of advance. Over the course of the eighteenth century life-expectancy for slaves must have increased. Early in the century the demographic regime was very harsh, and the slave population was maintained only through heavy importation. As the century progressed the improvement in conditions brought a decline in mortality and a rise in fertility (Menard 1995; Morgan 1983). This transition would be expected to have raised the value of slave labor even in the absence of improvements in productivity. We do not have evidence on interest rates in the Lower South, but Coclanis (1989, p.105) suggests they declined in the region. Elsewhere in the Atlantic world, interest rates appear to have been stable or falling (Homer and Sylla 1996, ch. 11).

of real slave prices is similar to the export per worker series in Table 2, though slave prices rose less after 1750, and fell less after 1770. Although slave prices fell sharply in 1740, around the time of the Stono rebellion, From 1720 through 1750 there was little change in the price of slaves. Beginning in 1750, and coinciding roughly with the expansion of indigo production, prices began to rise sharply, increasing by about 30 percent by 1770, and reaching a peak in 1775 that was more than 65 percent higher their 1750 level.[34] Prices fell sharply in the wake of the Revolutionary War, however, and fluctuated around their pre-1750 levels until the mid-1790s. After 1790, the diffusion of cotton appears to have stimulated a new rise in prices. In the decade after 1795 prices rose by one-third, and by 1805 were close to 20 percent above their 1720 level.[35]

The close parallels in the timing of movements in the exports per worker and slave price series suggest that both reflect real movements in the economy of the Lower South. That slave price movements were more muted than the swings in exports per worker is consistent with the view that they slave prices were influenced by the value of the domestically consumed food crops produced by slaves as well as by the value of the export crops they produced. From this perspective advances in productivity were attributable largely to the creation of new market opportunities as a result of external demand shocks. In the 1750s, British bounties helped to create a market for indigo that allowed planters to shift resources into more remunerative activities. After the Revolution these markets collapsed and reduced the value of labor

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[34] The percentage increase in the real slave price between 1750 and 1775 is on the same of order of magnitude as the increase in output per worker indicated by the narrative descriptions for the latter half of the century, but the timing of the improvement is different. The narrative histories suggested the improvements occurred more slowly and continued on up through the end of the century. The real slave price series indicates the improvements occurred in a much shorter time, but then dissipated by the end of the century.

[35] Mancall, Rosenbloom, and Weiss (2001) show that these fluctuations in slave prices were strongly correlated with variations in the importation of slaves into the region, providing further evidence that they reflect movements in the demand for slaves induced by shifts in labor productivity.

temporarily. But in the 1790s, growing demand for cotton combined with restrictions on other sources of supply created new opportunities to which planters responded. The resulting time pattern of productivity growth is one of little or no long-term growth from 1720 through 1750, followed by a rapid increase in the 1750s and early 1760s. In the 1780s productivity suffered a temporary setback, from which it recovered sometime in the late 1790s and early 1800s.

In the face of a relatively elastic long-run slave labor supply curve faced by planters in British North America in the eighteenth century, the finding that there was little long-run increase in labor productivity should not in fact be that surprising. The long-run stability of real slave prices implies that while technological and market forces contributed to shifts in the regional labor demand curve, the international labor supply response prevented these demand shocks from being translated into substantial permanent changes in labor productivity. Rather, the pronounced but temporary rise in real slave prices in the decade or two before the Revolution shows how external, market-driven shocks—British bounties on indigo, and rising European demand for rice—influenced the value of labor in the region. Demand shocks produced a temporary rise in the value of labor, which led in turn to an increase in the volume of slave imports. As the labor force expanded, labor productivity and slave prices adjusted downward until continued importation of slaves was no longer profitable.[36] Although the relatively elastic supply of labor to the region in the long-run meant that increases in labor productivity were temporary, the finding of no trend in the real price of slaves over the course of the eighteenth century does not rule out the possibility of improvements in total factor productivity. It simply means that if there were any such advances they would have had to have been reflected in increases in the prices of other (less elastically supplied) factors of production.

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[36] See Mancall, Rosenbloom, and Weiss (2001) for evidence of the supply response discussed here.

There is much less evidence concerning the value of other factor inputs in the eighteenth century, but there is some data on land prices, which is reproduced in Table 4.[37] In the colonial period, real land prices rose during the 1750s and 1760s, at about the same time that slave prices were also increasing, but then fell in the early 1770s. The lack of any long-term increase in land prices at this time is consistent with other scattered evidence that the supply of land was relatively elastic in the colonial era. As production expanded after 1750 planters were able to extend cultivation into previously unexploited lands in Georgia and the Cape Fear region of North Carolina. Furthermore, Loyalist compensation claims indicate that many South Carolina planters held large reserves of unimproved rice land at the time of the Revolution, which suggests that the principal obstacle to expansion was the ability to obtain enough labor to develop and cultivate this land (Nash 1992, p. 693). In the post-Revolutionary period land suitable for tidal irrigation was in relatively scarce supply. At the close of the eighteenth century swamps suited for tidal irrigation sold for about twice the price of inland swamps irrigated from ponds or reservoirs (Chaplin 1992, p. 43). Table 4 indicates that land prices had risen substantially by the 1790s, but without further evidence it is unclear whether this increase reflected a permanent increase in land prices or was a temporary response to the early phases of the cotton boom. Even if the increase were permanent however, the implied increase in total factor productivity is relatively small.[38]

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[37] The land price series in Table 4 is from Soltow (1989), who analyzed data recorded in deeds of sale for the area surrounding Charleston, South Carolina. To establish representative market values of farm land, Soltow edited all published deeds from the region, eliminating entries of less than three acres and those having implausibly low prices. In table 4 we reproduce his estimates and compare them to an index of export prices to trace movements in the real price of agricultural land.

4. Total Agricultural Output

Although the more moderate movements of slave prices over the century suggest that they likely reflect a broader array of influences than export data, even they would not adequately capture developments in those parts of the regional economy that were not based on slave labor or were isolated from external markets. Throughout the eighteenth century there were parts of the agricultural sector that did not rely on slave labor, especially in the backcountry. As the eighteenth century progressed, the relatively rapid growth of the backcountry population meant that an increasing fraction of the region's population was not producing goods for export.[39] If we hope to gauge how agricultural productivity advance affected the growth of colonial incomes and standards of living, it is essential that we have a fuller understanding of the improvements, if any, that were taking place in these burgeoning areas that were not involved in the export trade.

Although we cannot directly measure agricultural production for domestic consumption, it is possible to construct estimates based on reasonable assumptions about the behavior of consumption.[40] In so doing, we can explicitly identify key assumptions used to make the estimates, and can assess the sensitivity of our results by changing these assumptions.

We begin by breaking agricultural output into three components: food produced for domestic consumption in the Lower South, firewood, and exports. Food produced for domestic consumption equals food consumed minus any imports of food from other colonies. Agricultural exports include both items shipped abroad and those shipped to other colonies outside the region. Data are available to measure agricultural exports, imports of food, and firewood production, but

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[38] Assuming that land's share of total product was 25 percent, and attributing all of the post-Revolutionary increase in land prices to increased productivity, the increase in land prices in the 1790s implies that Total Factor Productivity increased no more than 13 percent between 1720 and 1798.

[39] Coclanis (1989, p. 75) shows how unimportant exports were to the backcountry.

[40] The approach that we develop to estimate agricultural production is similar to methods used to estimate agricultural production in Britain during the eighteenth century. For these efforts see, e.g., Allen (1999).

we lack direct evidence on food produced for domestic consumption.[41] Still we can estimate this figure as the difference between the demand for food in the region and imports of food into the region. The demand for food derives from the value of the diet enjoyed by different segments of the population. The average value of food consumed per capita is a weighted average of the value of food consumed by colonists and that consumed by slaves, where the weights are their respective shares of the population. Existing documents provide evidence on the diet or its components, and on the value of providing a specified diet for a number of different groups in the population—free settlers, soldiers, slaves, prisoners, charity cases, and so on—that allows us to estimate this crucial component of agricultural output.[42]

This evidence suggests that the diet of free colonists did not change much, if at all, over the course of the eighteenth century. There were undoubtedly variations reflecting the state of the harvest and booms and busts of the economy, but the underlying trend value appears to have been steady. Our baseline assumption then is that the value of an adult colonist's diet did not change from 1720 to 1800. The evidence is even clearer that the diet of an adult colonist differed from that of a child, so we assume throughout that the value of a child's diet remained at 50 percent of an adult's diet for the entire century.[43] The value of food consumed per colonists is thus a weighted average of that consumed by an adult and that consumed by a child, where the weights are their respective shares of the population.[44]

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[41] See Mancall, Rosenbloom and Weiss (In press) for an explanation of the data used to measure these components and the assumptions underlying them.

[42] The sources of this evidence include official colonial records, court cases, committee hearings, travelers' accounts, plantation records, and vestry minutes. For further discussion of these sources see Mancall, Rosenbloom and Weiss (In press).

[43] Changing the relative value of a child's diet affects the overall level of the value of consumption in each year, but has little effect on the trend over time.

[44] The evidence indicates that the value of a female's diet was lower than a male's, and so the weighted average would have changed over time as the female share of the population changed. We have chosen not to incorporate this refinement into our measure of farm production because it would have biased

It is also clear that the value of a slave's diet differed from that of a free colonist, but it is less obvious whether it rose over time or remained constant. We have specified the value of a slave's diet in 1800 and a lower value in 1700, and assumed that the value increased at a constant rate between those two dates. We put the 1800 value of the slave diet at 75 percent that of a colonist, or 6.2 cents per day ($23 per year) in 1840 prices.[45] We set the figure for 1700 equal to 75 percent of that 1800 value. We based that 1700 figure on Kahn's (1992, p. 532) estimate of the "least-cost diet with minimum fat requirements." His estimate was made for the period 1840-60, but is timeless in the sense that it was calculated to provide the calories and protein necessary to carry out the slave's tasks. His estimate for 1840-60 was approximately equal to 75 percent of the cost of the more typical slave diet that had been estimated by Fogel and Engerman (1974) or by Sutch (1974), so we assumed that the 1700 figure would equal 75 percent of our 1800 value.[46]

To estimate the agricultural labor force we employed procedures set out by Lebergott (1966) and Weiss (1992) to produce estimates for the nineteenth century. The total labor force is the sum of estimates of the numbers of free male workers, free female workers, and male and female slave workers, all aged 10 and over. The labor force in each population category is the product of the estimated population in that category and an assumed labor force participation rate. To obtain estimates of the agricultural labor force we broke workers into urban and rural

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downward the growth of output and output per worker. The female share of the population rose over time, and as it did so the weighted average of the diet would have declined and so too would the estimate of the value of food produced for domestic consumption.

[45] The 75 percent figure was based on the work of Klepp (1994, pp. 481-82). Gallman (1971, p. 72, Table 2) put the value of a typical slave diet at only one-third that of a free person, approximately 3.0 cents per day in 1840 prices. By valuing the components of the diet estimated by Fogel and Engerman (1974, p. 97) and Sutch (1974, p. 31) the value of the slave diet might have been as high as 8.0 cents per day in 1840 prices.

[46] Although there was much disagreement between Fogel and Engerman and Sutch on the details of the slave diet, the estimated costs of their diets were quite close, differing from one another by only about 6 percent.

categories and used agricultural participation rates specific to each group. We assumed that over the course of the eighteenth century the agricultural share of the labor force in both rural and urban areas declined at the same rate as the share for free workers declined in the first half of the nineteenth century. This most likely imparts a downward bias to the growth of the farm labor force, which in turn biases upward our measured growth in output per worker.[47]

Table 5 reports our estimates of the size of the agricultural labor force along with estimates of agricultural output based on our preferred assumption of stability in the value of the colonists' diet, along with several variations in which we assume positive rates of growth in the value of the colonists' diet over time. Reflecting the focus on long-term trends, these estimates suggest only small fluctuations in productivity over short intervals and those arose from variations in exports and in food imports. Over the entire colonial period our base-line estimates imply that productivity increased modestly, rising by about 7 percent from 1720 to 1770. From 1770 to 1800, in contrast, output per worker increased by a bit more than 20 percent, resulting in an increase over the longer term from 1720 to 1800 of approximately 30 percent.[48]

The estimates in the other columns in Table 5 indicate that output per worker would have increased more rapidly the faster the assumed rate of increase in the value of the diet. But the rates of productivity advance implied by these more optimistic assumptions about the diet seem

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[47] It is unlikely that the rural labor force shifted out of agriculture at the same speed as it did in the nineteenth century, and especially unlikely that the slave labor force did so. The decline in the shares over the eighteenth century must have been slower than that which occurred in the nineteenth century for two reasons. First, the rate of productivity growth in agriculture was likely slower in the eighteenth century than in the nineteenth and would have brought about a more gradual shift of the labor force out of agriculture for any given demand. Second, because incomes were higher and growing more rapidly in the nineteenth century, the higher income elasticity of demand for nonfarm products would have induced a more rapid shift in the composition of output away from farming.

[48] The rise in productivity after 1770 is a consequence of a sharp decline in labor force participation as a result of several demographic shifts within the region. Of particular importance was the decline in the share of slaves in the population. This effect was compounded by the relatively rapid rate of natural increase, which raised the share of children under 10 in both the free and slave populations at this time.

implausibly high. First, they seem high in light of the relative stagnation of our other measures of agricultural productivity. If the underlying components of the export sector, namely rice and indigo production, were the more dynamic and capital-intensive parts of agriculture, then we should expect to see more rapid productivity growth there. Second, the rates of productivity growth implied by these conjectures are rapid in comparison to the first half of the nineteenth century. Between 1800 and 1850, agricultural output per worker rose at an annual average rate of 0.24 percent.[49] The productivity advance required to support growth in the diet of only 0.2 percent per year between 1720 and 1800 would have been about twice as fast. Consequently if that alternative trend in the colonist's diet had occurred it had to have rested on an implausible rate of growth of agricultural productivity; higher rates of increase in the value of the diet imply even more implausible rates of productivity advance.

Furthermore, such high rates of growth in output per worker would had to have rested on rather low values of the diet in the earliest years. The ending year figures for the diet and for output per worker, i.e. those for 1800, do not change in these conjectures because they are in effect "known" values. Thus in order to have a higher rate of growth in the colonists' diet requires that the beginning year values be that much lower. In the case of a 0.2 percent annual growth in the diet, the per capita figure in 1720 would had to have been $26, while with growth of 0.4 percent the 1720 figure would had to have been $23. The latter figure is equal to the value of the diet we estimate the typical slave was consuming in 1800; the former is only 10 percent above that of a slave in 1800. While such figures may be plausible, it seems unlikely that they could have been that low and continued to attract the number of new colonists who made their way to the region.

As a result of the decline in the labor force participation rate, productivity had to rise if existing food consumption levels were to be maintained.

5. Conclusions about Agricultural Productivity in the Lower South

Our conclusions are summarized in Table 6 and Figure 1. Table 6 summarizes the rates of growth implied by our various labor productivity series while figure 1 shows the different partial productivity series as indexes set equal to 100 in the base year of 1720. As the evidence in Table 6 makes clear, long-run growth in labor productivity was modest. Between 1720 and 1800 our estimates range from minus 0.19 percent per year on average to 0.32 percent per year for our base-line conjectural series. But these modest long-run rates conceal more volatile short-run behavior. All of our series suggest at least some decline in productivity from 1720 to 1740, followed by more rapid increase after 1740. The series diverge after the Revolution: exports per worker and slave prices fell sharply, while estimates of total agricultural production imply that productivity growth accelerated.

Turning to Figure 1, the overall similarity of the movements in exports per worker and real slave prices is readily apparent. In contrast, the conjectural series appears considerably less volatile over the colonial period, dipping slightly in the 1740s, and growing more gradually in the 1760s. After the Revolution the conjectural series continues to grow while the other two series fall sharply. These differences suggest the importance of taking into account the large and relatively slow-growing domestic agricultural sector in the region. The performance of agriculture as a whole reflects changes in the export sector as well changes in that part producing for the domestic market. In the colonial period, the latter acted as a brake on the more rapidly growing export sector. On the other hand, in the post-Revolutionary period, the gradual progress

[49] This is the rate when GDP excludes home manufacturing and farm improvements. Weiss (1993 table 1).

of the domestic sector helped to insulate the economy from the depressing effects of the loss of international markets.

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Table 1:
Contemporary Observations of Indigo Output Per Worker

DATE	Pounds per Worker	Source
1749	60-160	Gov. James Glen
1757	90-180	Alexander Garden
1767	45	John Murray
1773	60	William Bartram
1775	100	*American Husbandry*
1784a	50	Porcher Family Account Book
1784b	125	John David Sheopf
1786	53	Porcher Family Account Book

Source: Chaplin (1993, p. 203).

Table 2:
Volume of Agricultural Exports per Slave Worker in Agriculture, South Carolina, 1720-1800

	Slaves				Exports per agricultural slave worker[a]				
Date	Total (1)	In Charleston (2)	Share 10 or older (3)	Agricultural Labor Force (4)	Rice (cwts.) (5)	Naval Stores (bbls.) (6)	Indigo (lbs.) (7)	Cotton (lbs.) (8)	Volume Index Per Agricultural Slave Worker (9)
1720	11,868	1,390	0.79	74,25	8.39	5.05			13.49
1730	20,000	1,859	0.77	12,611	12.77	1.29			14.08
1740	39,155	2,487	0.77	25,394	12.05	0.66			12.71
1750	40,000	3,327	0.77	25,299	12.02	0.69	2.27		13.90
1760	53,000	4,451	0.76	33,361	11.96	0.29	14.42		19.75
1770	75,178	6,275	0.76	46,913	13.98	0.26	11.97		20.46
1780	97,000	6,980[b]	0.73	59,332	1.92[c]		4.88[f]		1.94
1790	10,7094	7,684	0.70	62,513	7.26[d]		9.35	7.45	7.45
1800	14,6151	9,819	0.68	83,558	4.12[e]		0.12[g]	101.8	11.69

Notes and Sources to Table 2

Col. (1) Coclanis (1989, p. 64); Col. (2) Morgan (1984, p. 188) and Coclanis (1989, p. 115); Col. (3) calculated from demographic data in Menard (1995) and Morgan (1983); Col. (4) obtained by applying a 90 percent agricultural participation rate to slave population aged 10 or older not residing in Charleston; Cols. (5) –(7) 1710-1770 derived from Nash (1992, Table 6); Col. (5), 1790 and 1800 from Gray (1958, p. 1023) and U.S. Census Bureau (1975, series Z482); Col. (7) 1790 and 1800 Gray (1958, pp. 610-11); Col. (8) Derived by assuming that South Carolina's share of US cotton exports in 1790 and1800 was the same as its share of the nation's production in 1791(75%) and 1801(50%), respectively. Data on exports and production from Bruchey (1967, Table 3 A and 3 C); Col. (9) 1710-1770 derived from Nash (1992, Table 6) and Col. (4). To construct the volume index Nash (1992) converted non-rice exports to an equivalent value in terms of cwts. of rice on the basis of average prices calculated using all available data. To extend the series to 1790 and 1800 we calculated equivalent values based on post-Revolutionary prices, and used changes in the index between 1770 and the later dates to extrapolate Nash's 1770 value for the index. Prices of rice and cotton for the post-Revolutionary period are derived from Cole (1938, p. 154). Rice prices are an average for 1780-1800, cotton prices are an average for 1796-1805; the price of indigo is based on Gray (1958, p. 610), who reports that in 1792 indigo exports from South Carolina were 839,666 pounds and were worth $1.02 million.

a. Export values are 5-year averages centered on the date shown, unless otherwise noted. There were some exports of livestock and food in the early part of the century, but the amounts were small and declined over time. Because our volume index neglects this slower growing trade entirely, it overstates somewhat the rate of growth of exports.

b Estimated by interpolation between 1770 and 1790 values.

c Average of exports for 1782.

d Average of exports for 1788, 1790-1792; 1789 data are available only for part of the year.

e Average of exports for 1798-1800.

f Average of exports for 1780 and 1781.

g Average of Exports for 1798-1800.

Table 3:
Nominal and Real Prices of Slaves, South Carolina, 1720-1800

Date	Nominal Slave Price (dollars)	Export Price Index (1770 = 100)	Real Slave Price (prices of 1770)
1720[a]	110.37	66.54	165.88
1725	117.06	74.57	156.97
1730	113.65	70.48	161.26
1735	113.70	90.94	125.02
1740	93.05	82.66	112.58
1745	105.39	42.36	248.77
1750	138.10	83.43	165.52
1755	123.54	76.46	161.59
1760	160.44	76.99	208.40
1765	198.92	80.08	248.40
1770	215.11	100.00	215.11
1775	257.44	93.74	274.63
1780			
1785	276.87	182.84	151.42
1790	236.95	143.10	165.59
1795	246.52	173.29	142.26
1800	307.54	180.49	170.39
1805	347.67	181.40	191.66

Notes and Sources: Nominal slave prices from Mancall, Rosenbloom, and Weiss (2001). Export price data from Cole (1938, pp. 107, 154). To capture shifts in the structure of exports we construct the export index by chaining together indices for several shorter periods. From 1722 to 1747 the index uses the price of rice. From 1747 to 1775 it is a weighted average of rice and indigo prices with rice being given a weight of 0.75 and indigo a weight of 0.25. From 1775 to 1795 it is based on the price of rice. And from 1795 forward it is based on an unweighted average of rice and cotton prices. Figures for each year are five-year centered averages unless otherwise noted.

[a] Data for 1722-1725.

Table 4:
Nominal and Real Land Prices in Low Country South Carolina, 1720-1798

Period	Land Value (dollars/acre)	Export Price Index (1768-72=100)	Real Land Price Index (1720-24=100)
1720-24	1.25	66.54[a]	100.00
1725-29	1.26	76.49	87.57
1730-34	1.16	73.47	84.13
1735-39	0.94	96.70	51.66
1740-44	1.17	64.93	95.96
1745-49	1.45	54.21	142.20
1750-54	1.44	87.16	87.89
1755-59	2.08	74.96	147.56
1760-64	2.05	72.37	150.98
1765-69	2.04	88.41	123.03
1770-75	1.56	100.33	82.86
1794	3.44	162.89[b]	112.47
1798	4.39	156.04[c]	149.91

[a] Average price for the three-year period 1722-24.
[b] Average price for the three-year period 1793-95.
[c] Average price for the three-year period 1797-99.

Notes and Sources: Land values from Soltow (1989, pp. 202-3); Soltow reported land values deflated by the cost of living. To obtain nominal values we have multiplied his figures by the average cost of living index for the corresponding period derived from McCusker (1992, Table A-2). The export price index is the same as that used in Table 3, see the notes and sources for that table for a description of its construction.

Table 5:
Estimates of Agricultural Production and Agricultural Production per Worker,
Lower South, 1720-1800

Year	Agricultural Labor Force	Value of Agricultural Production (1840 dollars)						Value of Agricultural Production per worker (in 1840 dollars)		
		Estimates of Food Consumed								
		Base Case [a]	Var. A[b]	Var. B[c]	Food Imported	Firewood	Agricultural Exports	Base Case[a]	Var. A[b]	Var. B[c]
1720	15,609	1,040,592	926,035	828,250	29,977	163,263	323,001	95.90	88.56	82.30
1730	24,376	1,526,418	1,389,541	1,270,341	101,417	247,544	511,265	89.59	83.97	79.08
1740	45,690	2,879,533	2,661,397	2,467,586	316,694	464,242	1,022,315	88.63	83.85	79.61
1750	56,153	3,709,664	3,469,478	3,251,757	330,577	803,642	1,094,892	93.99	89.71	85.83
1760	81,865	5,463,224	5,182,289	4,922,474	448,192	1,203,615	2,358,104	104.77	101.34	98.16
1770	135,762	9,007,633	8,670,305	8,352,022	359,567	1,986,491	3,268,358	102.41	99.92	97.58
1800	344,235	30,184,719	30,184,719	30,184,719	1,145,964	6,658,683	7,072,233	124.25	124.25	124.25
	Average Annual Rates of Change									
1720-40	5.52	5.22	5.42	5.61	12.51	5.36	5.93	-0.39	-0.27	-0.17
1740-70	3.70	3.87	4.02	4.15	0.42	4.97	3.95	0.48	0.59	0.68
1770-1800	3.15	4.11	4.25	4.38	3.94	4.11	2.61	0.65	0.73	0.81
1720-70	4.42	4.41	4.58	4.73	5.09	5.12	4.74	0.13	0.24	0.34
1720-1800	3.94	4.30	4.45	4.60	4.66	4.74	3.93	0.32	0.42	0.52

[a] Base case assumes that the constant price value of the adult male diet remained constant between 1720 and 1800.

[b] Variant A assumes that the constant price value of the adult male diet increased at an average annual rate of 0.20 percent per year.

[c] Variant B assumes that the constant price value of the adult male diet increased at an average annual rate of 0.40 percent per year.

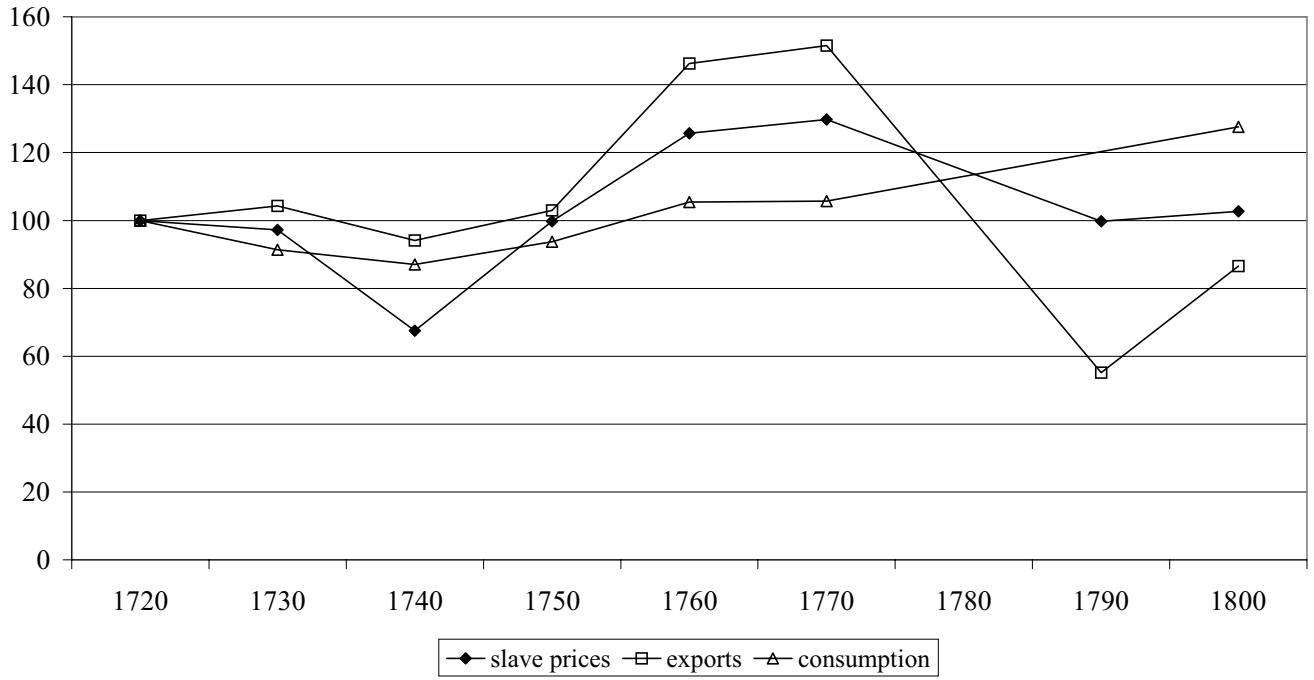
Notes and Sources: See Mancall, Rosenbloom, and Weiss (In Press).

Table 6
Annual Average Rates of Labor Productivity Chang in Agriculture
in the Lower South, 1720-1800

			Consumption Based Estimates		
			Assuming the value of the diet increased at an annual rate of		
Year	Exports per agricultural worker	Real Slave Prices	0%	0.20%	0.40%
1720-1740	-0.30	-1.94	-0.39	-0.27	-0.17
1740-1770	1.60	2.20	0.48	0.59	0.68
1770-1800	-1.85	-0.77	0.65	0.73	0.81
1720-1770	0.84	0.52	0.13	0.24	0.34
1720-1800	-0.18	0.03	0.32	0.42	0.52

Sources: Tables 2, 3 and 4.

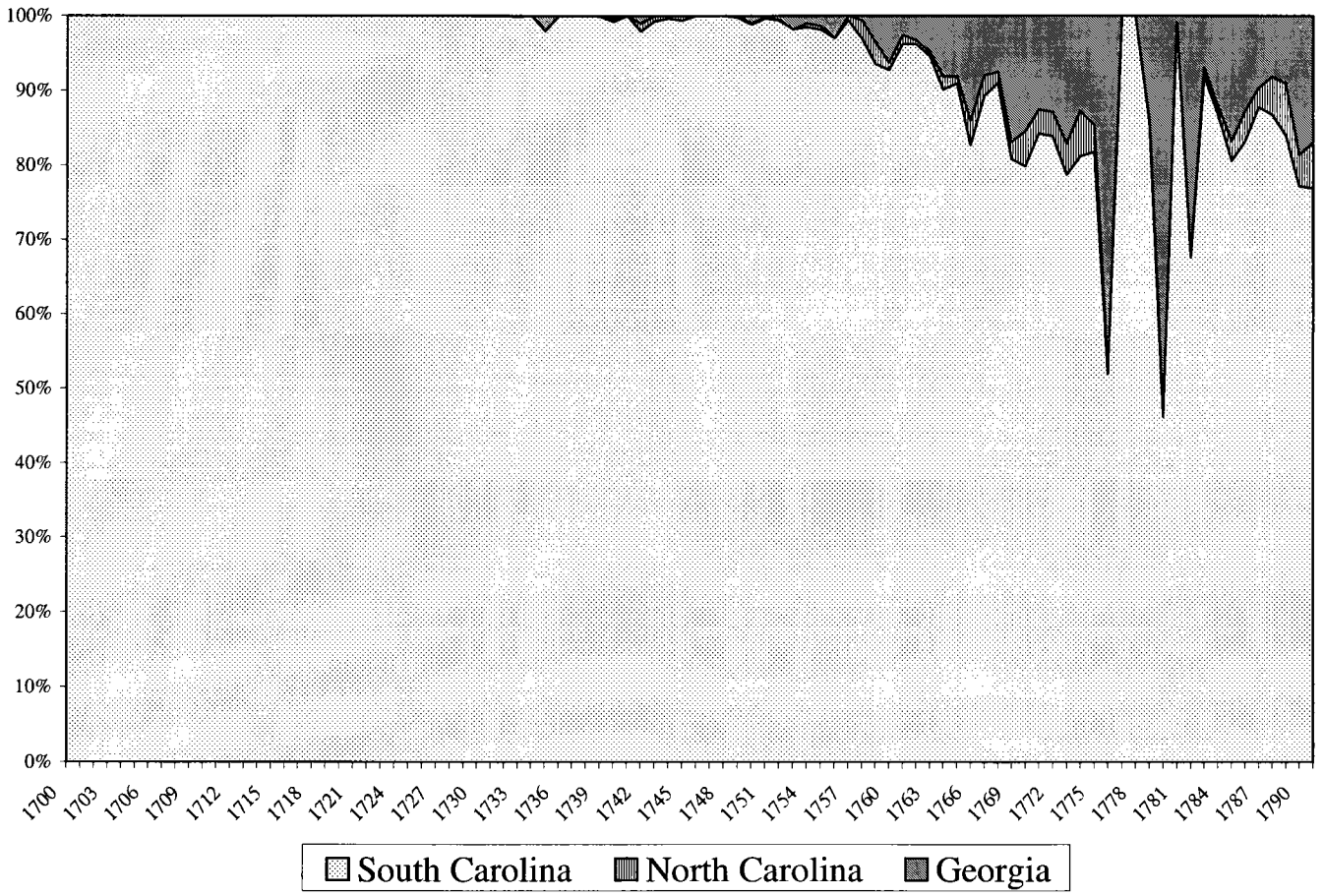
Figure 1:
Alternative Indexes of Agricultural Labor Productivity in the Lower South, 1720-1800



Source: Tables 2, 3, 4.

Figure 2:

Percentage Distribution of Exports from the Lower South to England and Scotland, by Colony 1700-1791



Source: U.S., Bureau of the Census (1975, series Z223-Z244).