THE INFLUENCE OF COST-SHARING PROGRAMS ON SOUTHERN NON-INDUSTRIAL PRIVATE FORESTS

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Thesis submitted to the faculty of the Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

Master of Science
in
Forestry

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December 12, 2001
Blacksburg, Virginia

Keywords: Forest policy, Production subsidy, Time series model, Random effects model

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Abstract

This study was undertaken in response to concerns that the decreasing levels of funding for government tree planting cost share programs will result in significant reductions in non-industrial private tree planting efforts in the South. The purpose of this study is to quantify how the funding of various cost share programs, and market signals interact and affect the level of private tree planting. The results indicate that the ACP, CRP, and Soil Bank programs have been more influential than the FIP, FRM, FSP, SIP, and State run subsidy programs. Reductions in the CRP funding will result in less tree planting; while it is not clear that funding reductions in FIP, or other programs targeted toward reforestation after harvest, will have a negative impact on tree planting levels.

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List of Acronyms

ACDP	Agricultural and Conservation Development Program
ACP	Agriculture Conservation Program
ASCS	Agricultural Stabilization and Conservation Service
BEA	Bureau of Economic Analysis
CFSA	Consolidated Farm Service Agency
CRP	Conservation Reserve Program
EQIP	Environmental Quality Improvement Program
FDP	Forest Development Program
FIP	Forestry Incentives Program
FRA	Forest Renewal Act
FRDP	Forest Resources Development Program
FRM	Forest Resource Management fund
FSA	Farm Service Agency
FSP	Forest Stewardship Program
GCC	Global Climate Change program
GLS	Generalized Least Squares
H.R.	House of Representatives
LAPs	Landowner Assistance Programs
NIPF	Non-industrial Private Forest
NRCS	Natural Resources Conservation Service
NTI	Nursery and Tree Improvement fund
OLS	Ordinary Least Squares
P.L.	Public Law
PTP	Plant-a-tree Program
REAP	Rural Environmental Assistance Program
RECP	Rural Environmental Conservation Program
RT	Reforestation of Timberlands program
SB	Soil Bank program
SIP	Stewardship Incentives Program
TRe	Texas Reforestation Foundation program
TSI	Timber Stand Improvement
USDA	United States Department of Agriculture

Chapter I. Introduction

I.1 Justification

In 1995, Agricultural Conservation Program (ACP) cost-sharing for tree planting was implemented on over 199,000 acres of non-industrial private forests (NIPFs) in the U.S.; however, by 1997 this program had been phased out (Moulton 1999). Total federal cost-sharing for private tree planting under all programs dropped from 419.4 thousand acres in 1995 to 144 thousand acres in 1997 (Robert Moulton, US Forest Service, personal communication, June 1999). Funding for the Forestry Incentives Program (FIP) was halved between 1994 and 1995 (USDA FSA, 1995). The Stewardship Incentive Program (SIP) has been terminated and only unspent funds remain to help landowners with projects designed under Forest Stewardship Program (FSP) management plans (Caron Gibson, US Forest Service, personal communication, June 2001). While now the termination of the FIP is currently debated in Washington D.C. (Robert Molleur, NRCS, personal communication, July 2001). These programs have been directed towards southern NIPF landowners[1]. What are the effects of these recent cuts in federal funding on tree planting? How have the funding levels of federal programs influenced private tree planting and what role are they playing now in the sustainability of NIPF forests? What is the effect of increasing levels of States own cost share programs?

Decreases in funding levels may lead to a drop in annual tree planting rates. A drop in annual tree planting in the South has implications for future wood supply and local wood processing industries. A quantitative study based on historical time series data is necessary to understand the effect of reduced funding. However, such a study should not only consider all federal cost share funding, but also include other forms of assistance, including funding for State run programs. No previous study has done this. The question of interest should be, what affects tree planting in the South and how does federal cost share funding fit into the system? Although previous researchers have analyzed this question in regard to forest investment in various forms, there have been no studies that include all the relevant cost-sharing at the regional level. This study shows

[1] For the purposes of this study the South is defined as Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.

the influence federal funding has played in the historic levels of private tree planting, the influence of different types of cost-sharing programs relative to other incentives and market forces, and the potential of cost-sharing as an instrument of government intervention. As the federal government debates the future of cost share programs, this study will be of use to Congressional committees, government officials, policy analysts, and taxpayers, in increasing our understanding of the shifting roles of government funded production subsidies.

I.2 Objectives

The primary objective of this study was to examine the implications of reduced federal forestry cost share funding on the sustainability of non-industrial private forestry in the southern United States. To meet the primary objective the following goals and contributing objectives were defined and listed in alphabetical order.

- To conduct a thorough literature review of forestry related cost share material.
- To determine the correlation between funding levels of federal and state cost-sharing programs relative to each other, and acres of NIPF planting by time series and cross-sectional time series econometric analysis.
- To quantify impacts of various market forces (for example, rising timber prices, increasing planting costs, or changes in State cost-sharing) that may or may not increase levels of NIPF tree planting in the absence of federal cost-sharing.

I.3 Southern non-industrial private forest landowners

I.3.1 Forest resource

In the Southern United States, 4.9 million private forest landowners own 187.1 million acres of forest. Ninety-five percent of these owners are non-industrial and own 61 percent of the land area, or about 115 million acres (Moulton and Birch, 1995). Historically, much of the now forested land in the South has been in and out of agricultural production one of more times (Knight, 1987). During the 20th century, the highest amount of land classified as timberland in the South, was during the 1960's at 197 million acres during which period there was a 10 million acre net increase in the area of timberland (Knight, 1987). On land classified as timberland, non-industrial private forest (NIPF) landowners hold between 37 and 41 percent of the softwood growing stock volume (Wear, 1996; Rosson Jr., 1995). Over the last 50 years NIPF landowners have planted over 27 million acres of trees at an average of over 500,000 acres per year (USDA NRCS, 2000). The history of NIPF tree planting is presented in figure 1.

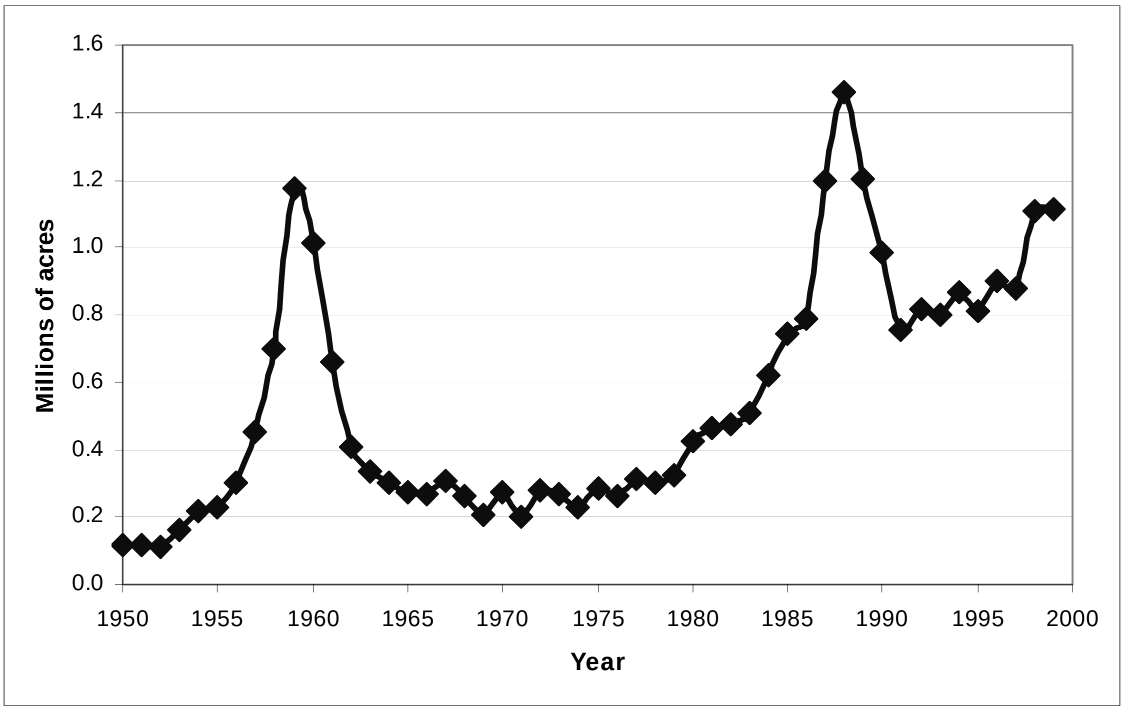

Figure 1: NIPF tree planting in the Southern States.

In total, the South accounts for over half of the annual softwood harvest in the United States (Cubbage *et al.*, 1995). However, Knight (1987) predicted that by the 1990's, softwood harvest would exceed growth. Cubbage *et al*. (1994) estimated softwood growth in the South at 88 percent of the harvest, suggesting that many areas will experience significant declines in softwood inventory. Pacheco *et al.* (1997) stated later, that South-wide, the softwood growth to removal ratio was 0.94:1 and that this ratio is expected to decline to 0.71:1 by 2020. This growth to harvest ratio is only likely to grow worse, as Dangerfield and Moorhead (1987) predict softwood harvests from the South rising 35 percent over the next fifty years. Kurtz *et al.* (1986) report that the problem of harvesting more timber than annual growth is particularly acute on NIPF lands.

I.3.2 Reforestation issues

Knight (1987) suggests that the drop in nearly 10 million acres of forestland since its peak in the 1960's is due to diversion to agricultural use and loss to urban development, and notes a major gap between the rates of pine harvest and regeneration on NIPF lands. Lord (1987) also suggests that mortality is a significant drain on softwood growth in the South, stating that as much as 15 percent of growth is lost to insects, disease, and fire.

In addition to urban development, agriculture, and mortality, Kaiser (1983) states that since the 1960's a substantial portion of the 1.5 million acres of softwood harvested annually has not been adequately regenerated. Through a survey of NIPF landowners through out the South, Kaiser (1983) found that seedlings were planted on only 35 percent of harvested clear-cut lands, and seed trees were used on only 9 percent of the land; however, what happened on the remaining 66 percent of the land is not known. In total less than a half of harvested acres were actively managed for regeneration (Kaiser, 1983). Flynn (1996) reports that the amount of NIPF land actively regenerated after harvest in the South may be as low as 25 percent.

This relatively low rate of active reforestation may be peculiar to the South, Johnson *et al.* (1999) report that, in Western Oregon, just under 70 percent of forest landowners have planted or plan to plant trees since their most recent harvest. Though regeneration may be undertaken, successful establishment is around 70 percent on NIPF lands, thus 30 percent of planted or actively regenerated NIPF land does not result in adequate reforestation (McWilliams, 1989). If regeneration effort on Southern NIPF lands is between 25 and 50 percent, and assuming land left to regenerate naturally does not result in satisfactory forest establishment (Flynn, 1996; Kaiser, 1983), then the actual percentage of NIPF lands successfully regenerated after harvest may be somewhere between 17 and 35 percent.

Knight (1987) stated that there are around 11 million acres of highly erodible cropland and pasture in the South suitable for timber regeneration. He also estimated that about 18 million acres of cropland and pasture would yield higher rates of return if converted to pine plantations. USDA Forest Service (1989) estimated these same figures at 8 million acres and 22 million acres respectively. Dangerfield and Moorhead (1997) estimates the area of erodible land at only several million acres. Bethea (1984) stated that there are at least one million acres of NIPF land in need of reforestation in Florida alone. Additionally, Texas has more than 1.6 million acres of NIPF land in need of reforestation (Barron, 1983). Despite this apparently large resource base and potential for expansion of the Southern forest resource, there has been no expansion of private forest investment (Wear, 1993), and recent levels of investment do not portend extensive growth in the future (Wear, 1996). Cubbage *et al.* (1995) conclude that large increases in timber inventories will be hard to achieve given urban and environmental pressures.

I.3.3 The NIPF problem

The timber supply from NIPF lands is a significant issue, as harvest from public land decreases (Newman and Wear, 1993). Wear (1996) discloses that the South accounted for 40 percent of the United States softwood harvest in 1952 and 50 percent in 1992. However, a large percentage of southern NIPF land is unavailable for timber harvest, due to the land use preferences of private landowners (McDill, 1997). Newman and Wear (1993) found that industry and NIPF landowner production behaviors are quite different. Significant numbers of NIPF landowners utilize their forests to capture non-market benefits (Newman and Wear, 1993).

Non-industrial private forestland has generally been considered a problem because it is apparently poorly managed (Yoho and James, 1958). The production of timber on NIPF land is only one half of the potential possible under intensive management (USDA ASCS, 1976). Most of the timber on these lands is in poor condition; generally it is cutover, under-stocked, and unmanaged (USDA ASCS, 1976). LeMaster (1978) defined the conventional view of the problem as NIPF lands producing below capacity, resulting in future timber shortages and wood prices rising to undesirable levels. Alternatively, Skok and Gregersen (1975) state that we will never face a shortage or a surplus of wood products if market forces are allowed to move in response to supply and demand through price signals in the market place.

I.3.4 Government Intervention

According to Skok and Gregersen (1975) government intervention on NIPF land would be justified if four assumptions about NIPF lands held: first that more wood is required than presently produced, and/or prices are going to rise faster than may be desired; second, NIPF lands should contribute more to the share of the nations' wood supply than they are currently providing, and that the benefits of increased timber supply are greater than the costs; third, that these increases in NIPF wood supply could be derived more efficiently than similar spending in the public or private industrial sectors; fourth, that there are divergences between public (social) and private benefits and costs in forestry that justify public involvement. Boyd and Hyde (1989) present justification for government intervention similarly: to mitigate the specter of market failure, to prevent timber famine, to mitigate the effects of poor price information which result in higher commodity prices, to redistribute income to landowners less well off, and to encourage maximum wood output. Wear and Newman (1992) say that justification for government involvement may also support external social benefits from tree planting, such as soil, water, wildlife, and biodiversity conservation.

Risbrudt (1983) says market failure exists for NIPF landowners, since apparently rising timber prices are not sufficient to induce NIPF landowners to invest in their forests. The unresponsiveness of NIPF landowners to price signals has been documented by Klosowski *et al.* (2001), Newman and Wear (1993), Brooks (1985), Royer (1985), and DeStieger (1983). However, Boyd and Hyde (1989) and Wear (1996) state that the case for market failure in NIPF timber investment and supply has not been convincingly shown, and no evidence exists to support claims of a shortage of reliable market information about timber prices or planting costs. Irland (1994) found that in general NIPF landowners tend to respond to market signals such as timber price changes and financial incentives. Lee *et al.* (1992) also find that landowners respond to market signals.

With camps divided on the existence of market failure due to conjecture about market responsiveness, NIPF landowners' reasons for not planting trees have been documented. Surveys in western Oregon and Washington found that private landowners were unwilling to reforest because, individually, they do not have the necessary funds, they are opposed to timber management and harvesting, they can enjoy a higher return on investment elsewhere, and hold concerns about government restrictions affecting their ability to recapture their investment when they harvest in the future (Johnson *et al.*, 1999). Kaiser (1983) found that most of those NIPF landowners in the South who chose not to actively promote regeneration did so because they thought that the land would regenerate naturally, they thought that reforestation costs were too high, they could not obtain cost-sharing, or that there was too much red tape in obtaining cost-sharing. Also, Wear (1996) alludes to risk as a substantial barrier to NIPF reforestation investment. Worrel and Irland (1975) list the obstacles to private reforestation investment as a lack of knowledge about forestry, a lack of interest, an incompatibility between timber production and the landowner's goals, a lack of sufficient financial returns from forestry, and a lack of some physical ability to undertake forestry practices. According to Haines (1995), landowners are hindered by a lack of capital, which results in a lack of tree planting optimization.

Chapter II. Literature review

II.1 Tree planting cost share programs

To address the NIPF tree-planting problem, as some have perceived, federal and state governments can pursue a number of options. Gregersen (1984) explains that three main types of public policy instruments are available to governments to affect private reforestation: direct public investment, regulation of private land and/or public action, and the use of incentives designed to encourage private action.

Henley *et al.* (1988) conclude that regulation of private land has led to significant improvements in NIPF reforestation. Although, at least in the case of Virginia's 1948 Seed Tree law, which required certain numbers of seed trees to be left after harvest, Hall and Starr (1985) said that regulation had been ineffective at maintaining the pine resource because there were a lack of resources to police the law.

Cost-sharing and extension have been the most common incentive programs used by the government (Gregersen, 1984). Tax incentives directed toward NIPF landowners are also widely available and are aimed at encouraging reforestation (Dennis, 1983; Meeks Jr., 1982). Costs related to reforestation may be capitalized, and up to $10,000 a year may be amortized from federal income tax for up to 7 years (Haney and Siegel, 2001).

Gregersen (1984) found that technical assistance is generally underutilized. However, many studies find that technical assistance does influence landowners to plant trees (Royer, 1985; Royer, 1987a; Royer, 1987b; Royer and Moulton, 1987; Royer and Vasievich, 1987; Hodges, 1989; Hyberg and Holthausen, 1989; Esseks *et al.*, 1992; Nagubadi *et al.*, 1996). This is not to say that landowners make poor decisions with regard to forest management and require guiding direction. Moulton and Cubbage (1990) found that landowners tend to make good use of best management practices whether assisted by technical help or not. Moulton *et al.* (1993) found that stand establishment was just as successful when reforestation tax incentives were used, which require no assistance, as cost-sharing programs, which do require technical assistance.

The influence of technical assistance may be quite small. Irland (1994) estimates that each full time equivalent forest extension staff member must deal with an average of

1.2 million acres of forestland, or 32,000 landowners. Mangold (1994) also notes that, historically, only one in ten NIPF landowners use technical assistance in reforestation activities. Not surprisingly, Skinner *et al.* (1989) could not find any influence of technical assistance in NIPF reforestation in the South.

The purpose of forestry related cost-sharing programs is to address the perceived problem related to the levels of NIPF tree planting (Ellefson and Wheatcraft, 1983; Kurtz *et al.*, 1986; Gaddis *et al.*, 1995; Haines, 1995). Haines (1995) also said that these programs are needed to counteract the increase of environmental regulations affecting NIPF lands, since often regulations can discourage forest investment through costs of compliance or the uncertainty of reaping the full investment at harvest. Federally funded programs aimed directly at tree planting on harvested forestland are the Forestry Incentives Program (FIP), the Forest Stewardship Program and the Stewardship Incentives Program. In addition, seven States in the South manage their own cost share programs specifically to aid NIPF tree planting.

Alternatively, some cost-sharing programs for NIPF tree planting have been aimed at removing agricultural lands from crop production, conserving soil and water, and reducing crop subsidies, as opposed to correcting a perceived lack of NIPF reforestation. Examples are the Agricultural Conservation Program (ACP), the Soil Bank, and the Conservation Reserve Program (CRP).

II.1.1 The Forestry Incentives Program (FIP)

The FIP was part of the Agriculture and Consumer Protection Act of 1973 (P.L. 93-86). Therein, Title X, the Rural Environmental Conservation Program (RECP), which was formerly the Agricultural Conservation Program (ACP), gave statutory authority for federal cost-sharing of timber production (USDA ASCS, 1976). The Act mandated that the FIP encourage development, management, and protection of NIPF lands (USDA ASCS, 1976).

According to Risbrubt and Ellefson (1983) the FIP was created to address low levels of private investment on NIPF lands and the resulting effect on the nation’s timber supply. Similarly, Ellefson and Wheatcraft (1983) state that the purpose of the FIP was to increase future timber supply. Gaddis *et al.* (1995) detail that the FIP was designed to mitigate reductions in timber supply from the West, soften the financial constraints on private lands due to environmental regulation, and provide more wood to meet increased demands for wood fiber. Cubbage *et al.* (1993) said the FIP was created as a result of successful lobbying by forestry interest groups who were trying to gain a program separate from the old ACP. According to Skok and Gregersen (1975), the forestry sector was lobbying for a separate program because they were unable to compete for funds under the ACP. These authors present three different views of the reasons for the creation of the FIP. Whether it was made to mitigate market failure, to overcome the effects of National forest policies and environmental regulation, or simply the result of successful lobbying, the intention of the FIP was to increase wood supply from NIPF lands (Risbrubt and Ellefson, 1983; Gaddis *et al.*, 1995; Cubbage *et al.*, 1993).

The FIP became a separately funded program in 1975 (USDA ASCS, 1980), and was further authorized by the Cooperative Forestry Assistance Act of 1978 (P.L. 95-313). In the 1990 Food, Agriculture, Conservation and Trade Act (P.L. 101-624) the FIP was scheduled to terminate at the end of 1995. However, under the Federal Agriculture Improvement and Reform Act of 1996 (P.L. 104-127) program management was changed from the Agricultural Stabilization and Conservation Service (ASCS) and the Forest Service to the Natural Resources Conservation Service (NRCS), and the FIP was authorized to continue until 2002. The Farm Security Act of 2001 under the first session of the 107th Congress is scheduled to repeal the FIP (H.R. 2646).

The FIP provides financial assistance to NIPF owners for tree planting and timber stand improvement (USDA CFSA, 1995) and includes non-timber goals (Wallace and Silver, 1983). Cost share payments are limited to $10,000 per person per year for up to 65 percent of the cost of installation (USDA NRCS, 2001). In the past, FIP cost-sharing has been as high as 75 percent, but was reduced in 1982 (Risbrubt and Ellefson, 1983). In order to qualify for the FIP, the applicant must be a non-industrial private landowner holding and enrolling between 10 and 1000 acres of forest, have land suitable for tree planting, and the land must meet the minimum productivity standards (USDA NRCS, 2001). The Secretary of Agriculture may also grant a waiver so that landowners holding up to 5000 acres may enroll (Risbrubt and Ellefson, 1983). State foresters and State ASCS committees determined the minimum standards for the FIP (Wallace and Silver, 1983). They also reviewed and approved applications, administered agreements, and issued cost share payments to landowners (Risbrubt and Ellefson, 1983).

Through the use of minimum standards for eligibility, efficiency is a major part of the FIP (Skok and Gregersen, 1975). Thus, the minimum land productivity level is generally set at fifty cubic feet of commercial timber per acre annually, with higher productivity sites receiving higher priority, depending on local ASCS committee direction (Risbrubt and Ellefson, 1983). Cubbage *et al.* (1993) indicates that some cronyism exists within these committees in rural areas, where local farmers have received FIP approval at the expense of the program standards and other eligible absentee landowners.

Risbrubt (1983) claims that the FIP has been one of the most analyzed USDA programs because many think it is an inefficient use of public funds. The FIP has been surrounded by controversy as some studies find the FIP an efficient and effective use of government money (Mills, 1976; Mills and Cain, 1979; Dicks *et al.*, 1983; Ellefson and Wheatcraft, 1983; Risbrubt and Ellefson, 1983; Kurtz *et al.*, 1986; Romm *et al.*, 1987; Lee *et al.*, 1992; Kurtz *et al.*, 1994; Gaddis *et al.*, 1995) while others find that the FIP is not efficient (Cohen, 1983; Boyd, 1984; Boyd and Hyde, 1989; Kluender *et al.*, 1999; Kline *et al.*, 2002).

Mills (1976) reported that the FIP is generally performing well. While later, Mills and Cain (1979) found that the internal rate of return for the 1974 participants was 11 percent with an average increase in volume per acre of around 94 cubic feet. Ellefson and Wheatcraft (1983) state that the FIP benefits people through the individual receipt funds, increased employment through FIP practices, community growth, increased business sales and the reduction of timber prices. Risbrubt and Ellefson (1983) found that the average federal cost per acre of reforestation had fallen as a result of improved program administration, a lowering of the cost share rate, and increased average tract size reforested thus yielding economies of size (Risbrubt and Ellefson 1983). Kurtz *et al.* (1986) report that FIP cost-sharing expenditures will be recovered in future taxes. In California, Romm *et al.* (1987) found that the FIP attracts landowners who would not have undertaken forest investment without the subsidy. Gaddis *et al.* (1995) state that there are secondary impacts of the FIP through the creation of private contracting vendors, an increase in softwood timber supply, and the sustaining of forest product manufacturing companies.

Conversely, Boyd (1984) calls the FIP distortionary in the market place as it affects more than just the discrete decision to manage forests. Boyd and Hyde (1989) claim that the FIP creates a net social welfare loss. Also, the effect of the stumpage price decreases due to the FIP is likely to lower the value of forestland. With a reduction in forestland values, industries and landholders who are not eligible for the FIP will face a loss in land value (Boyd and Hyde, 1989). They also claim that only those who utilize FIP for recreation and non-timber objectives receive unambiguous gains from the program. The subsidy to landowners may be negative if the transfer to consumers in the form of lower stumpage prices exceeds the returns to FIP-associated labor and capital inputs (Boyd and Hyde, 1989). However Boyd and Hyde's hypotheses, which hinge on the premise that the FIP will lower stumpage prices, may be premature if Kluender *et al.* (1999) are correct in finding that the FIP has neither slowed the real rate of timber price increases, nor expanded the supply of timber.

Despite the opposing views, under the FIP, 3.8 million acres of trees have been planted, 1.4 million acres of forestland have received timber stand improvement, and 50,000 acres of land have had site preparation to encourage natural forest regeneration (USDA NRCS, 2000). These accomplishments have come at a cost of $247 million over the life of the FIP (USDA NRCS, 2000; USDA FSA, 1995). With the change in the administrating agency from the ASCS to the NRCS in 1996, breakdowns of FIP spending by line item have been unavailable. However, as of 1995, $181 million had been spent on tree planting, $36 million had been spent on timber stand improvement, and $1 million had been spent on site preparation for natural forest regeneration. The South received the largest portions of these payments; figure 2 shows the distribution of these payments nationwide since program inception.

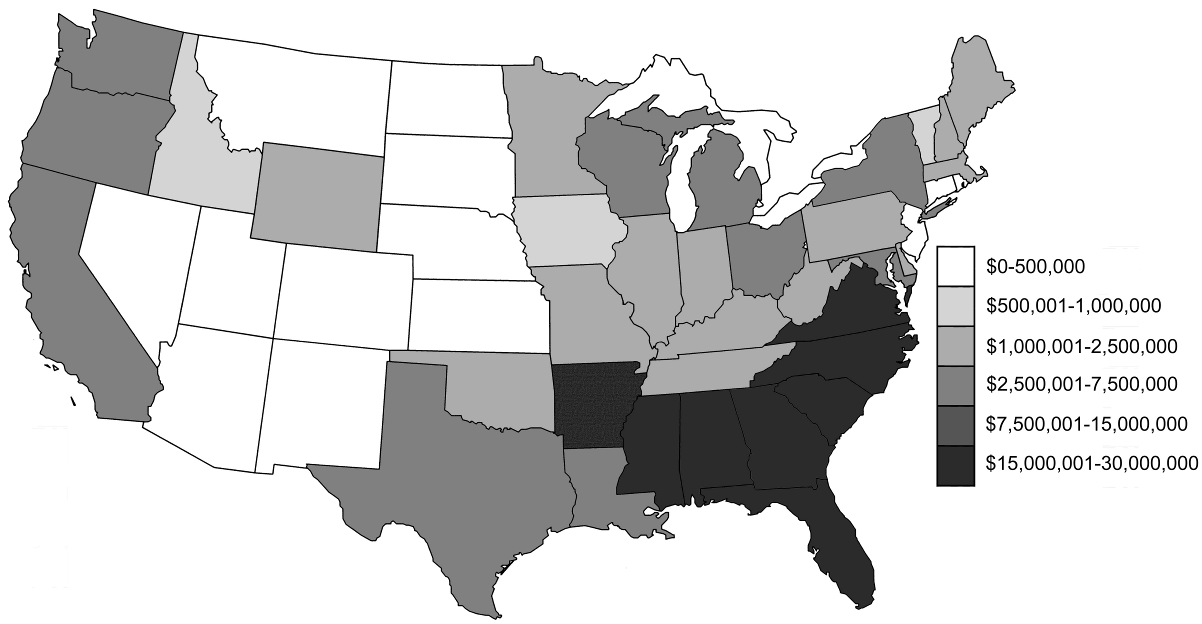

Figure 2: Distribution of FIP payments (1974-2000).

Fluctuations of the FIP budget and its ultimate demise have been the subject of concern (Moulton, 1999). Sampson and DeCoster (1997) criticized the reductions in the FIP budget since 1995 in the face of shifting harvest pressure from public to private lands. Ellefson and Wheatcraft (1983) foresaw the concerns of reduced FIP funding and suggested that forest industries could receive compensation for any loss resulting from a major shift in public policy. Figure 3 shows the downward trend in FIP funding, presented in nominal values.

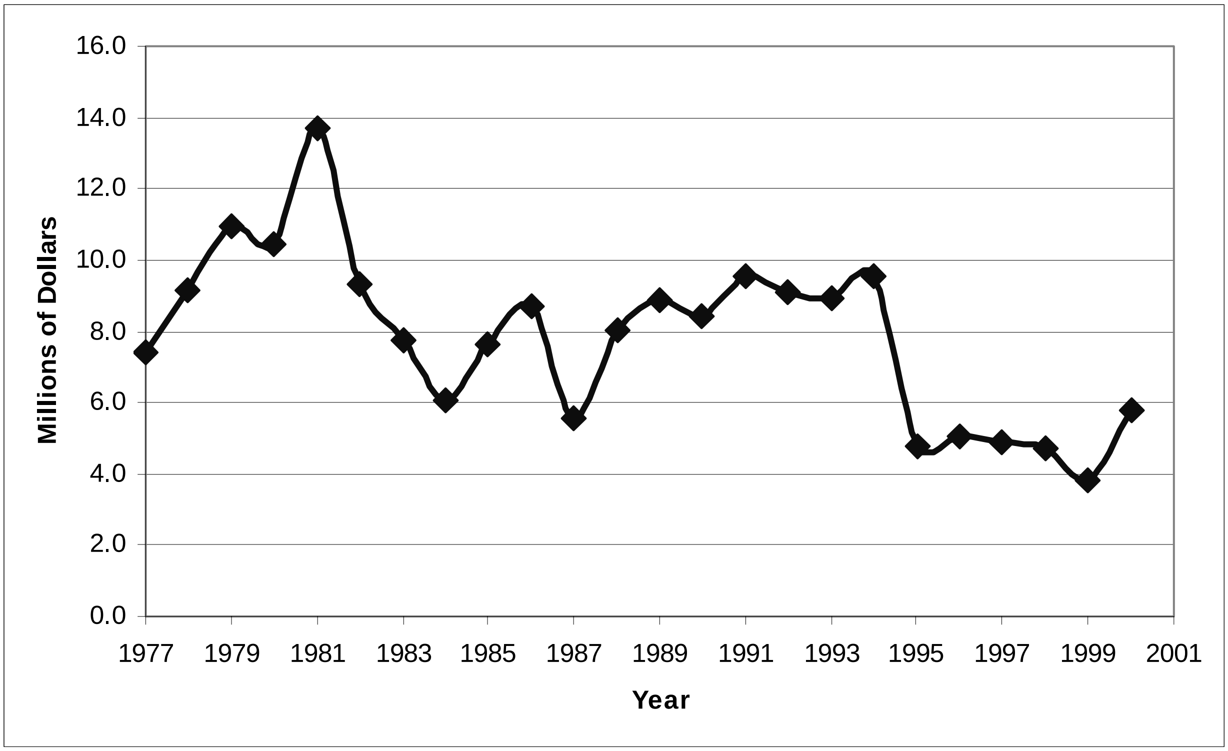

Figure 3: Funding of the FIP in the Southern States by year.

II.1.2 The Forest Stewardship Program (FSP) and the Stewardship Incentive Program (SIP)

The FSP and SIP programs were originally authorized in The Food, Agriculture, Conservation and Trade Act of 1990 (P.L. 101-624). They are part of legislation commonly know as America the Beautiful (Cubbage *et al.*, 1993). The FSP provides technical assistance through State forestry agencies to help NIPF landowners manage their forests, and in the SIP provides cost-sharing assistance (Esseks and Moulton, 2000). Under the FSP, landowners are assisted in preparing a forest management plan if they agree to follow it (P.L. 101-624). Participation in the FSP is a necessary requirement to receiving cost-sharing funds under the SIP (P.L. 101-624).

The FSP and SIP were scheduled to replace the FIP as the principle cost-sharing system for, among other things, planting trees (Cubbage *et al.*, 1993). However, unlike the FIP, the joint FSP/SIP includes broader aspects of multiple-use and environmental protection (P.L. 101-624), which appeased environmentalists who were primarily concerned with global warming, and this aided its passage. The legislation supports nine types of activities: the creation of forest stewardship plans, tree planting activities, forest improvement activities, agroforestry activities, practices to protect soil and water, practices to improve or protect riparian and wetland resources, fisheries habitat enhancements, wildlife habitat enhancements, and forest recreational enhancements (USDA FSA, 2000).

The FSP/SIP and FIP guidelines for cost share eligibility are similar. A landowner must have a management plan prepared under the FSP, or under the SIP-1 code. However, few States have included the latter option in their management of the SIP (New *et al.*, 1997). Landowners must obtain no more than 50 percent of their income from primary forest products processing. They must also hold less than 1,000 acres of forest, though a waiver can be obtained for ownerships up to 5,000 acres (New *et al.*, 1997). There is no minimum acreage, but practices that are cost shared under the SIP must remain for at least 10 years after completion (P.L. 101-624). In meeting these requirements, landowners can receive reimbursement for up to 75 percent of the cost (New *et al.*, 1997).

The FSP has been evaluated by several recent surveys. Esseks and Moulton (2000) found that few of the survey participants who had not started to implement their plans said their inaction was because of a lack of money. They also found that in the South, half of the survey participants with active plans received cost-sharing assistance. Of these, 60 percent would not have done as much plan implementation without the cost share funding. Esseks and Moulton also found that after participation in the program, 10 percent of landowners were more likely to consider harvesting timber for money. Egan *et al.* (2001) found, from their survey of FSP participants in West Virginia, that around 78 percent were satisfied with their forest management plan and that recommended practices were very likely to be implemented. However, they were not able to establish the degree to which those practices would have been carried out without the influence of the plan. Melfi *et al.* (1996) report that 79 percent of FSP participants surveyed would have carried out FSP recommendations without the program. They also report findings similar to Esseks and Moulton (2000) that the FSP increased timber production as a primary goal for landowners by around 10 percent.

Melfi *et al.* (1996) found that 14 percent of SIP cost share recipients were able to do things they would have otherwise been unable to afford. New *et al.* (1997) note that since the SIP requires the whole forest to have an approved management plan, while the FIP does not, some landowners, not wanting to commit all their land to the SIP, have opted to reforest under the FIP.

Since 1991, the SIP has spent $60 million on funding projects, with the largest amount, $23 million spent on tree planting projects resulting in almost 400,000 acres reforested (USDA FSA, 2000). Around 78 percent of tree planting has occurred in the South (New *et al.*, 1997). The distribution of SIP payments nationwide is shown in figure 4.

As of 2000, the FSP had enrolled 13,919 landowners, with 1.5 million acres of land (Catalog of Federal Domestic Assistance, 2001). The original goal of the FSP was to enroll 25 million acres of land by 1996 (P.L. 101-624).

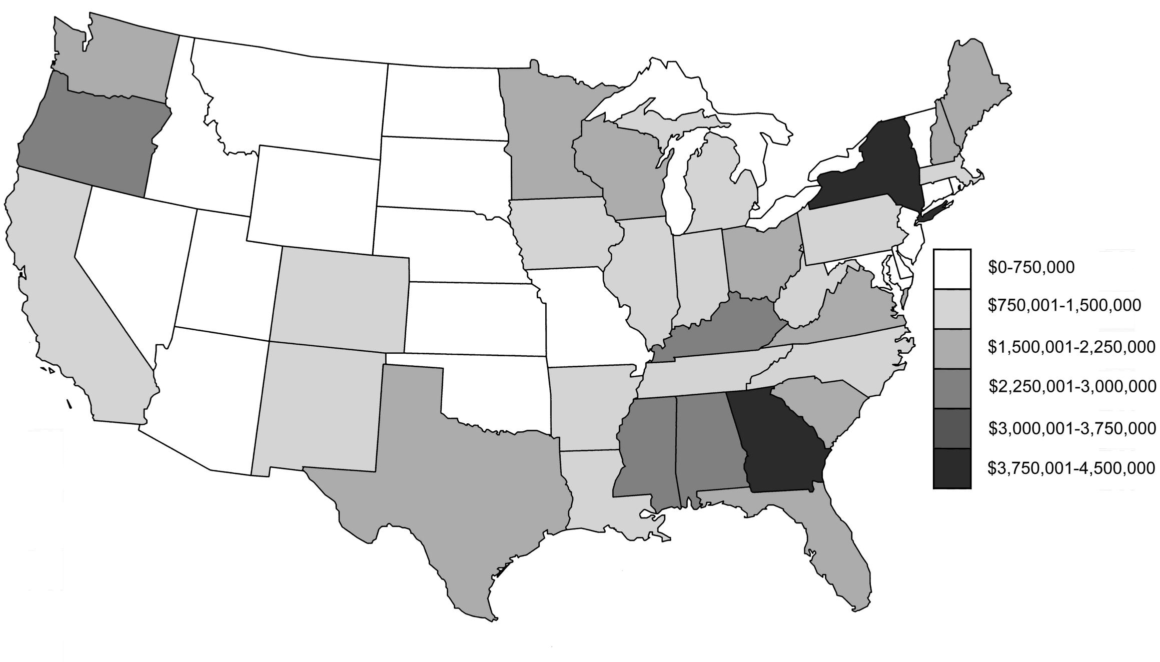

Figure 4: Distribution of SIP payments (1992-2000).

The SIP is to be repealed along with the FIP under the Farm Security Act of 2001 (H.R. 2646). Although Section 5, the FSP, is to remain and become a part of the new Forest Land Enhancement Program (H.R. 2646).

II.1.3 Forest Resource Management funds (FRM).

The FRM, administered by the State and Private Forestry branch of the Forest Service, provides funds for State Forestry Agencies to assist NIPF landowners in forest planning, watershed management, and providing technical and financial assistance (Cubbage *et al.*, 1996). The FRM also includes the Nursery and Tree Improvement program (NTI), which helps fund State nurseries and seed tree operations to benefit NIPF landowners (USDA Forest Service, 1978; Cubbage *et al.*, 1996).

II.1.4 The Agricultural Conservation Program (ACP)

The ACP was originally authorized through the Soil and Domestic Allotment Act of 1936 (USDA ASCS, 1979) and was to provide cost-sharing payments to farmers affected by the dust bowl problems of the 1930s (Cubbage *et al.*, 1993). These payments were to encourage soil and water conservation practices; a small portion of these payments has been used for tree planting on marginal cropland (James and Schallau, 1961; Cubbage *et al.*, 1993). It provided assistance for up to 75 percent of the cost of performing enduring conservation practices up to a maximum of $3500 per year (Zinn, 1995). However, the repeal of the ACP in the Federal Agriculture Improvement and Reform Act of 1996 (P.L. 104-127) and its incorporation in the Environmental Quality Improvement Program (EQIP) eliminated ACP tree planting.

The ACP had also been terminated in 1972 after the 1971 name change to the Rural Environmental Assistance Program (REAP). However, a successful civil action reinstated the ACP in 1974 as the Rural Environmental Conservation Program (RECP), which changed back to the ACP in 1975 (USDA, ASCS, 1975). It was this 1974 RECP that included within it the first FIP payments. During these years, the ACP funding of tree planting initially rose in 1972 with a push for enduring conservation measures, but then dropped precipitously when it was terminated and reinstated as can be seen in figure 5.

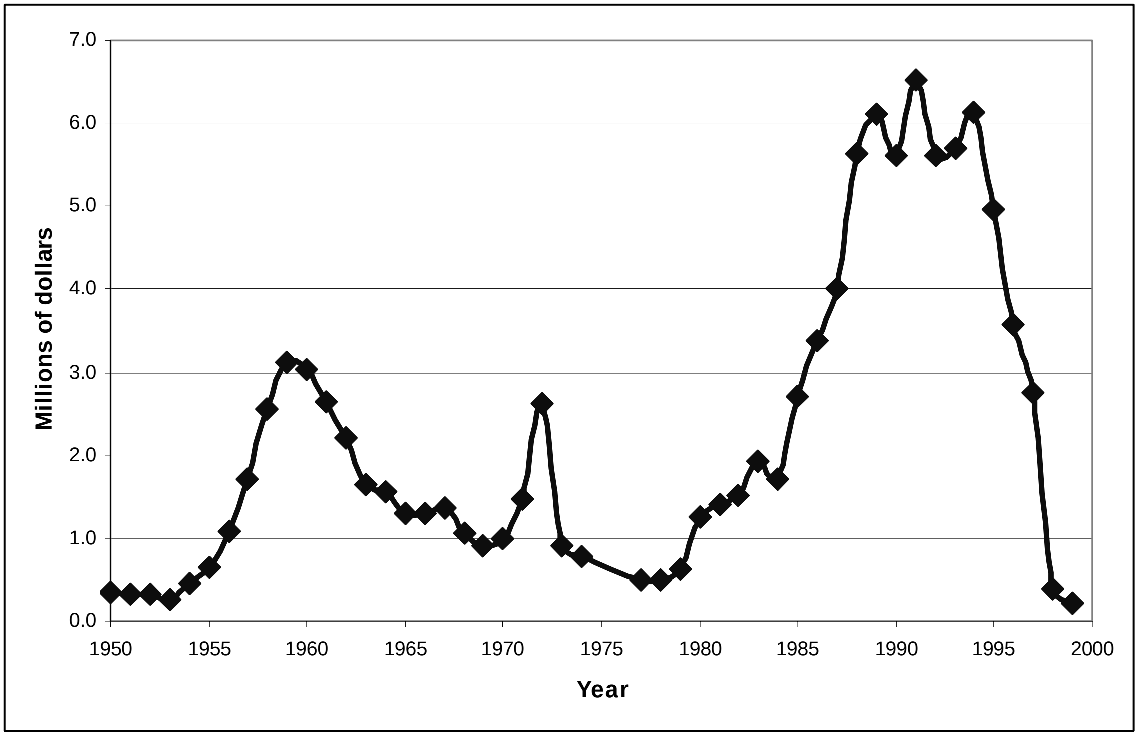

Figure 5: ACP funding of tree planting in the Southern States by year.

Kurtz *et al.* (1994) found that 76 percent of ACP plantings were still in the original plantings, with 10 percent reverting to other tree species, 6 percent lost to urban development, and 3 percent converted to other land uses.

Until 1995, when the ACP was terminated, there had been just over 7 million acres of trees planted (USDA FSA, 1997). The top five States each had over half a million acres planted and were all in the South (USDA FSA, 1997). Figure 6 shows the distribution of acres planted in trees under the ACP.

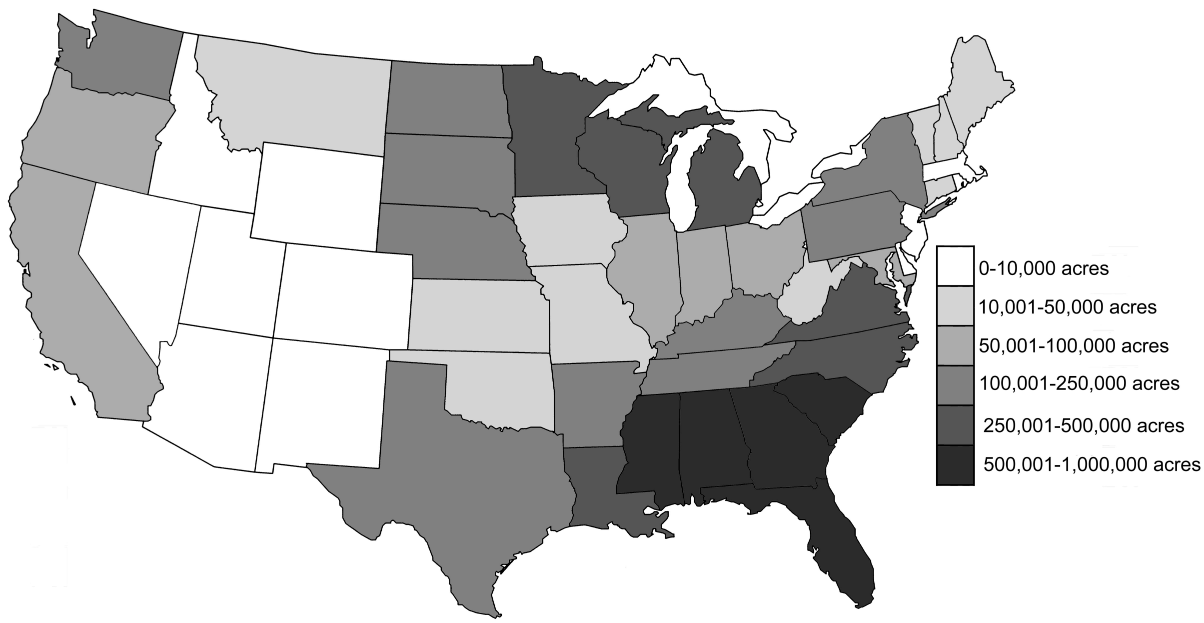

Figure 6: Distribution of ACP tree planting (1936-1999).

II.1.5 The Soil Bank

The Agricultural Act of 1956 (P.L. 84-540), also known as the Soil Bank Act, was aimed at reducing excessive agricultural production, resulting from subsidization since the 1930's (Cubbage *et al.*, 1993). This Act included the Acreage Reserve Program, which was designed to reduce cropland acreage immediately through direct payments, and the Conservation Reserve Program, which was a long term approach to reducing cropland acreage (Swingler, 1956). Tree planting came under the Conservation Reserve Program and was known as Soil Bank planting (Kurtz *et al.*, 1994).

The Soil Bank program was funded for a five-year period from 1956 to 1960, with funding scheduled to decline to zero by 1970 (USDA ASCS, 1960). However, the Food and Agriculture Act repealed the Soil Bank Act in 1965 (P.L. 89-321).

Despite the Soil Bank's brief history, 2.2 million acres of trees were planted at a cost of just over $10 million (USDA ASCS, 1963). Similar to the ACP, these payments went primarily to the South. Figure 7 shows the distribution of Soil Bank tree planting payments.

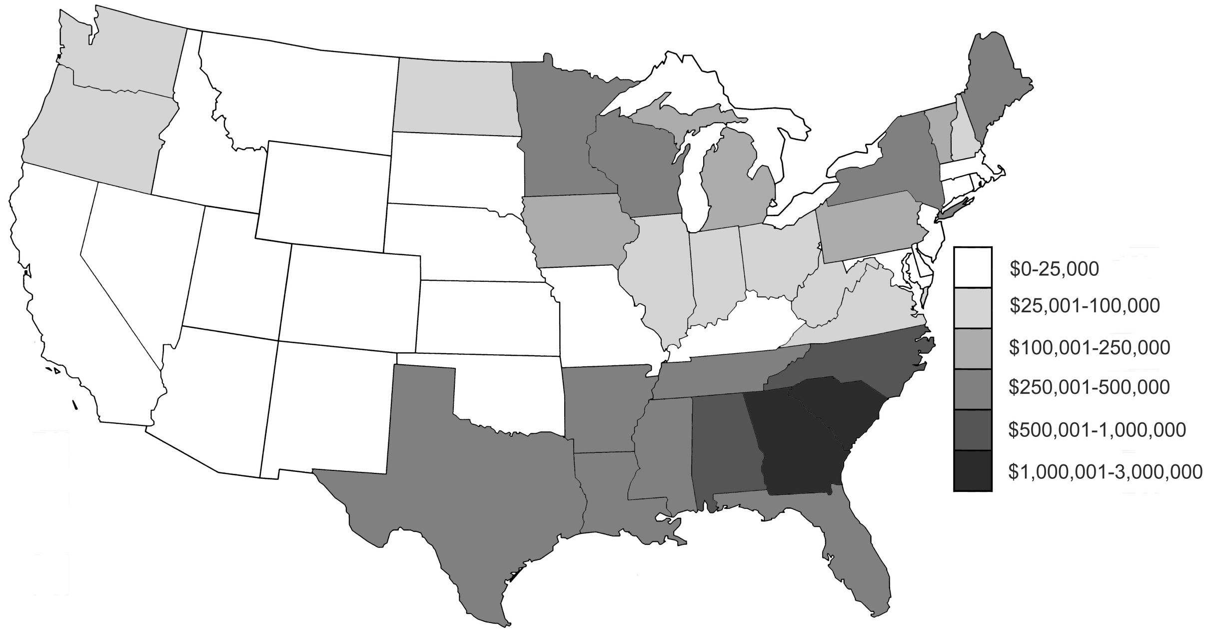

Figure 7: Distribution of Soil Bank tree planting payments (1956-1963).

Kurtz *et al.* (1994) surveyed 5000 acres of Soil Bank forests and found that 80 percent still remained as forestland, with 41 percent having been replanted, 35 percent in the original planting, and 4 percent of the land was found in other tree species. Of the remaining land, only 2.5 percent had returned to agricultural cropland (Kurtz *et al.*, 1994). Marsinko and Nodine (1981) analyzed an hypothesized Soil Bank planting, and found that the real internal rate of return was 6.3 percent on one full rotation. However, according to Cubbage *et al.* (1993), the Soil Bank program failed at reducing crop production, despite the number and longevity of acres planted in trees.

II.1.6 The Conservation Reserve Program (CRP)

The CRP, modeled after the original Soil Bank CRP, was authorized through the passage of the Food Security Act of 1985 (Cubbage *et al.*, 1993, P.L. 99-198). However, it was aimed at soil conservation and wildlife habitat program rather than crop reduction (Cubbage *et al.*, 1993). The CRP is expected to continue until 2011 under the Farm Security Act of 2001 (H.R. 2646).

Under the CRP, landowners can receive payments for converting their marginal agricultural land to other uses, followed by rental payments for a period of ten to fifteen years (P.L. 106-580). Unlike the Soil Bank, which included all agricultural land, the CRP deals only with marginal and erodible land (Cubbage *et al.*, 1993). Landowners submit a price on their land for which they are willing to remove it from crop production, these bids are then ranked and the lowest bids are accepted until funds are exhausted (P.L. 106-580; Cubbage *et al.***,** 1993).

Although the CRP legislation directed that 12.5 percent of enrolled CRP lands should be planted in trees at each sign up period at a 50 percent cost share rate, only half that has been accomplished (Zinn, 1995; Moulton 1994b). Esseks *et al.* (1992) report that only in the 6th signup period did the CRP come close to reaching that goal. Nevertheless, as of 2001, almost 3 million acres of trees have been planted under the CRP, a significant portion of which occurred the second year of the program in 1987 (USDA FSA, 2001).

Cost-sharing for tree planting under the CRP has fluctuated greatly. In 1994-95 there were no funds available, while in 1987, $22 million was spent on tree planting alone (USDA FSA, 2001). Over the life of the program just over $150 million has been spent on tree planting, with associated rental payments at over $130 million (USDA FSA, 2001). The top five States receiving CRP money for tree planting have all been in the South, the largest being Georgia, which received just over $62 million. Figure 8 shows the distribution of CRP tree planting payments.

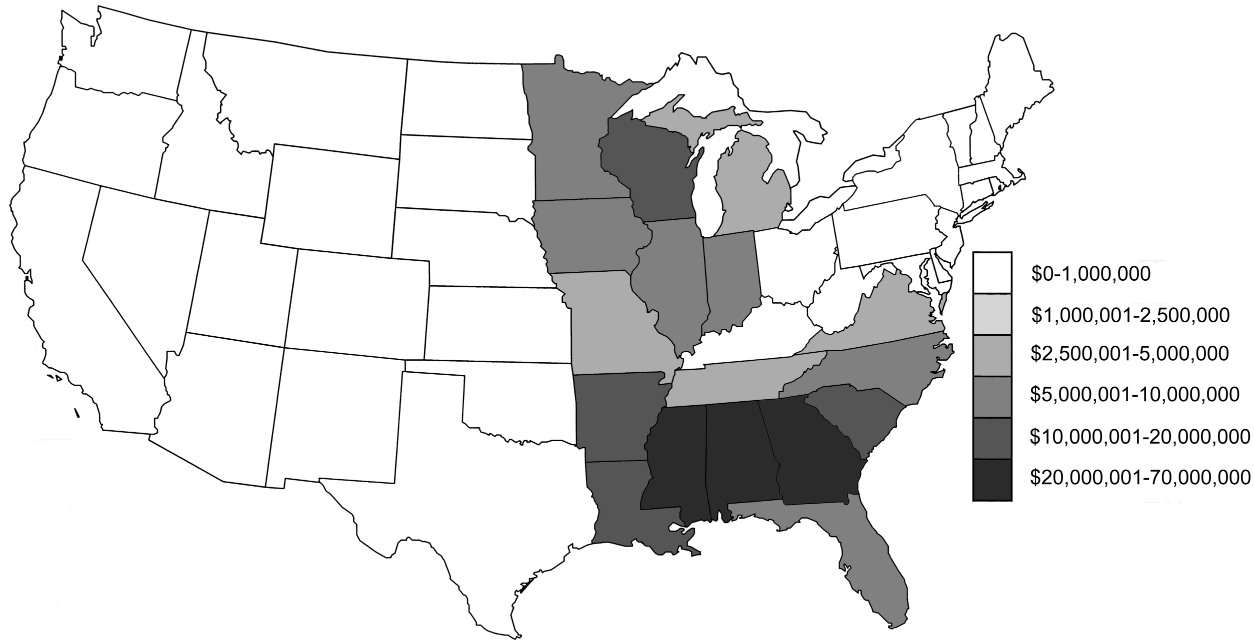

Figure 8: Distribution of CRP tree planting payments (1986-2000).

II.1.7 Other Federal programs

A small tree-planting component of the 1963 Cropland Conservation Program yielded 4,493 acres of cost shared acres with just under $150,000 spent, only $2600 of which was spent in the South. The Global Climate Change (GCC) program, also not well known, was part President Clinton's 1993 Climate Change Action Plan (Moulton, 1994a). It was designed to sequester atmospheric carbon through tree planting on NIPF lands, principally through the expansion of the SIP (US Global Change Research Information Office, 2001). Initially, 23 000 acres of trees were planted under the accounting procedures of the FIP and SIP, but the program had fallen into obscurity by 1994 (Moulton, 1994a).

II.1.8 Southern State programs

The following southern States currently offer NIPF afforestation cost-sharing: Alabama (Agricultural and Conservation Development Program (ACDP)), Mississippi (Forest Resources Development Program (FRDP)), North Carolina (Forest Renewal Act (FRA)), the South Carolina (Forest Renewal Program (FRP)), Texas (Reforestation

Foundation Program (TRe)), Virginia (Reforestation of Timberlands Act (RT)). Unlike other States, the South has seen increases in State forestry program budgets (Cubbage and Lickwar, 1988). Nominal funding levels for the southern States NIPF forestry programs are found in figure 9.

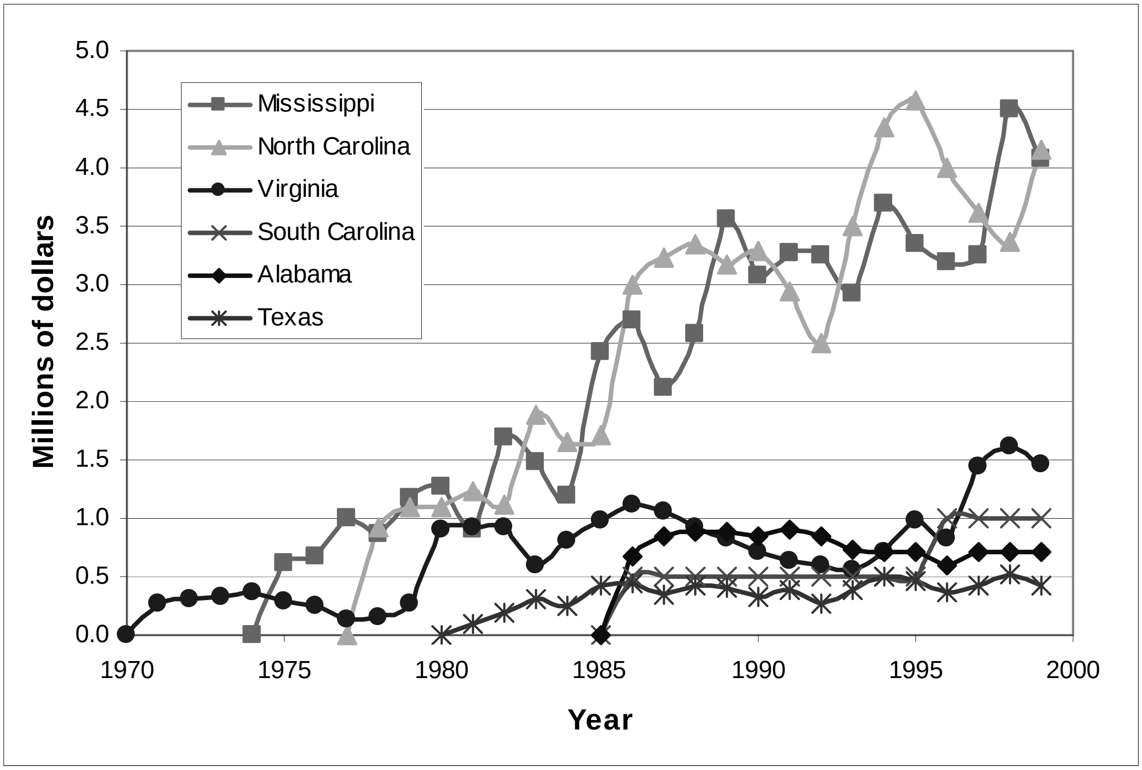

Figure 9: Funding levels of southern State NIPF tree planting programs.

Alabama's ACDP was established in 1985 (Hoven and Hubbard, 1994). The purpose of the program is soil conservation, water quality improvement, and forestry improvement with around one third of funds spent on assisting landowners to plant trees (Tim Albritton, Alabama Forestry Commission, personal communication, January 2001). Under the program, NIPF landowners can cost share up to 60 percent of costs, to a maximum of $3,500 (Roy Kendrick, Alabama Soil & Water Conservation Commission, personal communication, June 2001). Funding for the ACDP has remained steady over the life of the program, with tree planting cost-sharing expenditures varying at a little less than $1 million each year.

Mississippi runs the second oldest State tree planting cost-sharing program, the FRDP, which is funded by a timber severance tax and offers 50 to 75 percent cost-sharing with a maximum of $5,000 per year (Mississippi Forestry Commission, 1996). Since the start of the program in 1974, over one million acres have been reforested at a cost of over $62 million (Mississippi Forestry Commission, 2001). In addition to the FRDP, Mississippi also runs its own reforestation tax credit, which allows for 50 percent of the cost of reforestation to be used as a credit on State income tax (Mississippi Forestry Commission, 1999). The tax credit and cost share payment programs cannot be used co-jointly except for low-income landowners, and there is a $10,000 lifetime credit limit (Mississippi Forestry Commission, 1999).

North Carolina's program started in 1977 and reimburses 40 to 60 percent of reforestation costs (Mehmood and Zhang, 1999). Funding has increased to over $4 million annually, with just under $60 million spent since 1977 (Joann Hocutt, North Carolina Department of Environment and Natural Resources, personal communication, January 2001).

South Carolina's FRP was created in 1982 with 50 percent cost-sharing only on areas between 10 and 100 acres (Hoven and Hubbard, 1994; Mehmood and Zhang, 1999). Funding remained at $500,000 between 1983 and 1996, after which it increased to $1 million (Mike Bozzo, South Carolina Forestry Commission personal communication, January 2001). Since inception, the program has cost $10 million with 90 percent spent on reforestation (Mike Bozzo, South Carolina Forestry Commission personal communication, January 2001). Three quarters of the FRP funds come from a timber severance tax and the rest from the State General Assembly (Mike Bozzo, South Carolina Forestry Commission personal communication, January 2001).

The Texas TRe started in 1981 and is funded by the forest industry within the State (Barden and Casey, 1998). Interestingly, the TRe also received $300,000 in federal money in 1994 through the efforts of a Congressperson from Texas (Brad Barber, Texas Forest Service, personal communication, January 2001). Fifty percent cost shares are paid on tracts over 10 acres (Mehmood and Zhang, 1999). Since the program began, just over $7 million has been spent on the TRe (Brad Barber, Texas Forest Service, personal communication, January 2001).

The oldest State cost share program is Virginia's 1971 RT, which offers cost-sharing with a maximum payment of $75 per acre (Mehmood and Zhang, 1999). In addition to reforestation costs, the RT funds site preparation costs like herbicide release applications, and pre-commercial thinning costs (Phil Grimm, Virginia Department of Forestry, personal communication, January 2001).

In Florida, the Florida Reforestation Incentives Program (FRIP) operated in the early 1980s, and the Plant a Tree Program in the early 1990s. The FRIP lasted for a few years receiving $10,000 each year plus several million free seedlings for use on NIPF lands from the forest industry (Jim Harrel, Florida Division of Forestry, personal communication, January 2001; Bethea, 1984). While the Plant a Tree program was authorized to take up to $250,000 in annual donations from the forest industry for rural and urban tree planting projects, it only received $70,250, and dispersed about $54,000 (Jim Harrel, Florida Division of Forestry, personal communication, November 2001).

II.2 Tree planting studies

There have been numerous investigations into NIPF tree planting. Researchers have often modeled Southern tree planting behavior, and many of these models include variables to explore the relationship between government subsidization of tree planting and tree planting. These model results are tabulated in Appendix B. In examining the relationship between tree planting and subsidization, researchers have tackled three central themes. These are the attributes of participants in landowner cost share programs, the effect of subsidies on non-cost shared forestry investment, and the effect of landowner cost-sharing on timber supply, whether measured in harvest volume or in proxy as tree planting effort.

Numerous models and surveys have determined the attributes of landowners who participate in cost share programs. Such studies are used as an evaluation tool to report on the uptake of the program, and recommend target groups most likely to participate in the future, but they are limited to predicting whether an individual landowner might participate or not.

Some studies try to determine the percentage of landowners who accept payments for investments they would have made without government subsidies. These studies generally address the reasons why landowners behave certain ways in response to government subsidies.

Other studies of NIPF tree planting behavior look at the effect of programs, or their components, on timber supply. Models of this type seek to predict levels of change in timber supply with changes in levels of cost-sharing or the presence of absence of programs. Depending on the methodology of the study, parts of all three may be within the scope of the study. Most contain elements of at least two.

II.2.1 Landowner choice studies

One of the earliest studies of NIPF landowners and government subsidization of tree planting was by Yoho and James (1958). They surveyed forest landowners in Northern Michigan to assess the characteristics and attitudes of landowners in regard to four major programs: forestry extension, forestry service programs, Soil Conservation Districts, and the ACP. A significant finding in this survey was that half of those who enrolled in the ACP would have undertaken the forest practices without the cost-sharing money given to them.

Webster and Stoltenberg (1959) conducted a survey of forest landowners in southern New York, hoping to find variables that would predict landowners' responses to forestry programs. They found that the only significant variable was the size of the landowner's forest. The other variables, occupation, timber value, the age of the landowner, and distance to the forest holding, were not significant. Expanding on this finding, Webster and Stoltenberg modified the forestland acreage variable to become a proxy for landowner wealth. Through this examination the authors found that forestry program adopters were significantly wealthier than non-adopters. This result seems to lend credence to Yoho and James' (1958) finding, that half of the ACP money recipients in northern Michigan would have undertaken the practices without subsidization, since one would expect wealthier landowners to be in a better position to invest in forestry practices than less wealthy landowners.

Harou (1983) surveyed participants in the ACP and FIP from Massachusetts and found that 56 percent of those ACP participants surveyed would have carried out the practices without cost-sharing. Additionally, Harou found that 30 percent of those FIP participants surveyed who received money for pre-commercial thinning said they would have thinned without the cost share assistance.

Schuster (1983) built a logit model that analyzed the characteristics of NIPF landowners in Montana who used technical assistance programs for, among other things, reforestation. Schuster found that larger forestland ownership and geographic location of the land were significant variables.

Royer (1985) modeled the influence of public policy and landowner characteristics on individual reforestation investment probability in the South. Based on survey data from landowners who harvested between 1971 and 1981, he found that public financial and technical assistance explained the highest proportion of variation in reforestation and concluded that these programs were more influential than markets or ownership attributes in determining landowner reforestation behavior.

These types of models reveal the influence of cost-sharing in the decision framework of the individual landowner and subsequently the effect on the individual's probability of reforestation if cost-sharing is removed. These models alone do not, however, provide insight into the effects on aggregate timber supply through changes in the decision variables, such as those considered by policy makers. These types of models can only, at best, provide qualitative information to policy makers. These models can aid in understanding whether more or less of something is better, and how existing programs can be targeted to specific demographic groups. For example, the results in Royer (1985), suggest that lower replanting costs, raising the average cost share amount paid, increasing technical assistance, or increasing stumpage price results in a greater propensity for landowners to reforest. It also shows that landowners with larger forest holdings are more likely to reforest; therefore, cost share programs could be targeted toward these individuals to increase reforestation. Absolute costs and benefits from specific changes cannot be determined. Recognizing this, Royer concludes that more research is needed to gauge what would happen to the already modest levels of reforestation if cost share funding was reduced

Romm, Tuazon, and Washburn (1987) estimated the probability of forestry investment by landowner characteristic variables only, using logit regression techniques similar to Royer (1985). This model was based on survey data of Northern Californian landowners in order to analyze the design of NIPF policy, particularly in regard to reforestation programs. Based on their findings that high income and full-time residency at the forest are the strongest indicators of forest investment, Romm *et al.* suggest forestry program features can be targeted toward specific groups. They report that the appropriate choice of target depends on the relationship between program requirements and landowner motives and characteristics. Minimum acreage requirements on program enrollment would have a negative effect if applied to tree planting programs, since they exclude those groups of landowners in California, those with smaller land holdings, who are most likely to plant trees on their land. This kind of qualitative information on NIPF landowners is useful in tailoring forestry incentive programs to groups of landowners.

Royer (1987a) looked at the reforestation probability question again and used the same data as he had before (Royer, 1985) only now certain dummy variables were added in an attempt to determine the factors influencing reforestation after harvesting. Both knowledge of cost-sharing and the technical assistance dummy variables were found significant. In comparing previous reforestation models and harvest choice models, Royer found conflict regarding the influence of market variables and what these conclusions meant for the appropriate role of government intervention. If landowners were not responsive to market variables, then the case for government intervention was strengthened. One point of primary concern to Royer was the variation in findings of landowners' responses to stumpage prices in previous models. In Royer's case, the finding was that pulpwood stumpage price but not sawtimber stumpage price was significant. Royer concluded that, since private investors do not enjoy the potential longevity of partnerships and corporations, the reforestation option is often rejected, and hence programs of financial and technical assistance are imperative in order to increase the nation's rate of reforestation. To further strengthen Royer's thoughts on the need for cost-sharing he states:

> "The strength of the cost-sharing coefficient suggests much of the increase in reforestation in the South has been stimulated by federal and state cost-sharing. Continuation of such programs would seem prudent in the light of the mixed responses to price signals." (Royer, 1987a)

Additionally, Royer expounds the results of the income variable in this manner:

> "For landowners with below average incomes, [cost-sharing] would seem to indicate a way to overcome capital constraints; for landowners with above average income this would seem to be a way of making the reforestation investment option more competitive with other investments." (Royer, 1987a)

Cautiously, however, Royer said that in the latter case there might be some substitution of public funds for private investment. Ellefson and Wheatcraft (1983) found that at least 59 percent of 1981 FIP participants owned land to the value of $95,000 or more; 23 percent owned land valued at over $230,000. Lorenzo and Beard (1996) found that most users of the SIP in Louisiana were landowners with middle to high income in addition to the acres of forest owned. The amount of forestland owned, the value of land owned, and landowner personal income are likely to be closely correlated. Reflecting upon the findings of Yoho and James (1958), Webster and Stoltenberg (1959), and the studies above, in regard to program participation and wealth, there may be significant capital substitution.

Royer (1987b) further expanded the discussion of the appropriate role of government in reforestation policy by investigating the interaction of reforestation cost-sharing and tax incentives through a survey of landowners in North Carolina. Royer used the same logit regression techniques as in previous NIPF models. By including variables for the knowledge of cost share programs and the knowledge of tax incentives in the analysis, Royer found that while the dummy variable for cost-sharing was significant at the 0.05 level, the dummy for tax incentives was not. Based on this finding, coupled with the high incidence of using both tax incentives and cost share programs, Royer concluded that, while two different programs are available, only one would be necessary. This lead Royer to posit three alternatives; first, that tax credits and cost-sharing programs could be mutually exclusive as to NIPF participation, second, that cost-sharing could be made available for practices not covered by the tax credit, a variation on the first idea, or third, that one program could be eliminated.

In Royer's model, landowners with higher income were more likely to reforest. This not only has implications for capital substitution, but also Royer states that retaining the tax credit program at the expense of the cost share program, would be an advantage those landowners with higher incomes. While retaining the cost share program only, would eliminate the tax credit, which has the most universal appeal. Megalos and Cubbage (2000) back up this assertion that most landowners in North Carolina prefer the tax credit program. Their survey of landowners in North Carolina revealed that the tax credit is twice as popular as cost share programs.

Royer and Moulton (1987) conclude that tax incentives and cost-sharing combined result in a higher propensity for reforestation than either program alone. These results come from a logit regression analysis of survey data from across the South. The variables included are almost identical as Royer (1987b) except for the addition of a timber price variable. Royer and Moulton find that both familiarity with tax credits and cost share program dummy variables are significant and that their coefficients in the model are almost identical, suggesting that their effect on South wide reforestation efforts is additive when used together.

Royer and Vasievich (1987) also produce a logit model of reforestation investment, using not only the 1971 to 1981 survey data previously used by Royer (1987a) but also another Southern regional survey conducted in 1983. This report looked into the response of landowners to market incentives, finding that the three dummy variables, technical assistance, knowledge of cost-sharing, and familiarity with tax incentives, were significant, yet the economic returns variable was not (Royer and Vasievich, 1987). The authors concluded that landowners are more likely motivated by the satisfaction associated with reforestation than pecuniary returns (Royer and Vasievich, 1987). The results indicate that landowners are sensitive to reforestation costs whether reforesting for satisfaction or monetary investment (Royer and Vasievich, 1987). Subsequently, landowners are more likely to reforest if the government reduces their cost of reforestation through cost share programs (Royer and Vasievich, 1987).

Hyberg and Holthausen (1989) examined whether NIPF landowners were strictly profit maximizers, solely interested in pecuniary returns, or if they maximized utility for some bundle or goods provided through forest ownership. The authors thought that if the latter were true, public programs intending to increase the supply of timber would have a smaller impact than expected, and that in many cases these programs will subsidize private consumption of non-market goods. The logit regression analysis was based on survey data collected from landowners in Georgia between 1977 and 1984 to estimate models for timber harvest and also reforestation.

Hyberg and Holthausen (1989) posited that the clearest test in determining if landowners were utility or profit maximizers would be the sign of the income coefficient in the timber harvest regression. They thought that a significant and negative income coefficient would suggest landowners with more wealth would delay timber harvest and enjoy the non-timber benefits of the mature forest. They also hypothesized that a positive coefficient for the income variable in the reforestation model would indicate that, after harvest, wealthier landowners would reforest sooner to again enjoy the non-timber benefits from the forest.

Hyberg and Holthausen (1989) found that the coefficients of the income variables were as expected, negative in the harvest decision model, and positive in the reforestation model. Their conclusion followed from their hypothesis, that the utility maximizing approach to NIPF modeling is more consistent than the strictly profit maximizing approach, and that forestry incentive programs subsidize the private consumption of non-market goods. Studies of capital substitution in replanting debate the efficiency of subsidies. This study questions the effectiveness of reforestation subsidies; subsidies may result in extra reforestation but at the same time may not result in any extra timber supply.

Hodges (1989) used tobit regression to analyze reforestation survey responses of landowners in southern Arkansas/northern Louisiana and in the Georgia piedmont. Landowners in the two regions were surveyed and asked to relate all the forestry investment decisions they had made in the last ten years, along with information on the use of technical assistance, land characteristics, education, and knowledge of financial incentives. The dependent variable in the model was the estimated dollars of forestry investment, which included reforestation, site preparation, and timber stand improvement. In this model, knowledge of cost-sharing and financial incentives was found significant in the decision to invest in forestry. In terms of policy implications, the results of this study indicate that cost-sharing is good for forest investment, and, in order to increase reforestation, more might be done to promote awareness of public programs.

Analyzing another variation on the decision framework of NIPF landowner tree planting, Esseks *et al.* (1992) investigated the factors that influence CRP-enrolled landowners to plant trees on marginal agricultural land. This study did not include landowners' expectations of financial returns through forestry investment, but focused on landowner variables in order to make broad recommendations on the marketing approach and target groups to increase CRP tree planting. Their logit regression analysis found that previous experience with forestry or forestry personnel are significant factors influencing the landowner's decision to plant trees. As has been the case with other studies of this type, their conclusions and recommendations are qualitative. They advise forestry agencies that reforestation cost-sharing should be aimed at landowners who do not derive a significant portion of their income from their land, and that landowners should be contacted by public agencies at the time they are considering what to plant under the CRP.

Bell *et al.* (1994) apply a logit model to analyze Tennessee forest landowner participation in the FSP. Essentially their results are the same as those found in Esseks *et al.* and previous logit model analyses. This study concluded that targeting the cost share program toward those that have had previous experience with forestry and/or those that have inquired about information on forestry and conservation practices is the most effective approach to increasing program adoption. The authors recommend that fostering a more favorable attitude toward the goals of a program may have more influence than increasing monetary incentives. While these types of studies recommend that incentive programs should target landowners with experience in forestry, such an approach my transfer income to those who might have undertaken those practices anyway. Similarly, if the goals of the FSP are to prevent or mitigate environmentally unsound practices and increase responsible stewardship, then perhaps the program should target those that do not have a favorable attitude to the program goals. The recommendation to target those that do may be like preaching to the choir.

Lorenzo and Beard (1996) investigated the factors affecting Louisiana NIPF landowners using the SIP. From their survey they found that higher income and larger forestland holding were significant in the use of the SIP.

Nagubadi *et al.* (1996) studied the factors that influence NIPF landowner participation in cost share programs. They built a model based on survey data from landowners in Indiana, using probit analysis to predict the probability of cost share program participation. Their analysis included variables relating to landowner characteristics, woodland and management characteristics, sources of information, and attitudes toward easements and property rights. The results obtained and conclusions drawn were almost identical to the other studies of NIPF landowner reforestation probability. They found that larger landowners were more likely to participate. The authors concluded that one must understand the characteristics, motivations, and attitudes of landowners to ensure program effectiveness and that marketing strategies based on their findings need to be developed. They recommend that programs should provide close personal contact with landowners, and target those who have sought prior information about programs and those who are involved with forestry organizations or commercial forestry. Their conclusions are remarkably like those in Bell *et al.* (1994), and parallel the results of other reforestation probability models. They imply that reforestation programs should be targeted toward those owners most likely to reforest without assistance.

Conway (1998) estimated a logit model of landowner reforestation finding that debt load, slope of the land, and the desire to leave timber as an inheritance were significant variables. Cost-sharing was not explicitly analyzed in this study.

Crabtree *et al.* (1999) modeled landowner entry into a farm woodland incentive scheme in Scotland. Their study focused on farmer participation and found that larger landowners were more likely to participate. There was a 50 percent likelihood that landowners, who did not know about the program, would participate if they were educated about the program. Based on these results Crabtree *et al.* concluded educating uninformed farmers about the program would not increase participation even though the marginal cost of informing an additional landowner is not presented. In their mind, a better approach was to target those landowners that have predisposing characteristics to program participation, that being those who have large land holdings, and previous experience with tree planting.

Kluender *et al.* (1999) surveyed NIPF landowners in Arkansas and found that forestry incentive users tended to be wealthier, better educated, and have goals for generating income from timber sales.

All studies of reforestation probability indicate that landowners with large holdings are most likely to reforest and generally landowners with previous experience in forestry, particularly those with commercial intentions are predisposed to program participation. Most state that programs should be targeted toward those that have had previous experience in forestry, particularly with commercial motivations. However, these landowners are more likely to reforest without the aid of cost-sharing than others. Additionally ethical concerns could be raised about cost share programs that transfer funds to those with above-average incomes and assets.

Landowner decision choice models have extensively explored NIPF tree planting behavior. Royer (1985), Romm *et al.* (1987) Royer (1987a), Royer (1987b), Royer and Moulton (1987), Royer and Vasievich (1987), Hodges (1989), as well as Hyberg and Holthausen (1989) Hardie and Parks (1991), Hardie and Parks (1996), and Conway (1998) all produce decision choice models investigating the probability of reforestation. From these models, all but one estimating southern reforestation, reforestation characteristics emerge. Cost-sharing, technical assistance, and stumpage price are found to be significant and positively correlated with reforestation probability. The cost of reforestation is also found significant and negatively correlated in all models. Landowner income and size of land holding were hypothesized to be positively related but were not found significant in all models. Also, tax incentives were positively correlated and significant in two of three models.

Further studies, Esseks *et al.* (1992), Bell *et al.* (1994), Nagubadi *et al.* (1996), and Crabtree *et al.* (1998), use the binary choice model to investigate the probability of landowner participation in cost-sharing programs. The use of technical assistance was significant and positively correlated to participation in the two models where it was included. Income was significant and positively correlated in three of the four models. The number of acres held by the owner was significant and positive in two of the four models. Only one included reforestation cost and found it was significant and negatively correlated. Interestingly none of these four models included a stumpage price variable or some other form of expected return on investment.

In total, these studies present a pattern of reforestation trends. The following will increase the likelihood of a landowner planting trees: higher income, larger landholding, technical assistance, higher expected rates of return on forest investment, previous experience in forestry, and lower costs of planting.

II.2.2 Cross-sectional studies

Skinner *et al.* (1990) produced a model of NIPF planting based on survey data collected from across the South to principally investigate the impact of technical assistance. Skinner *et al.* analyzed reforestation in the 1985 planting season across 29 contiguous areas with respect to the number of private and public foresters and other market and land characteristic variables. The analysis was strictly cross-sectional, taking a snapshot in time to look at the influences on reforestation for that year. The cost-sharing dollars variable was provided from survey information from State Foresters' offices and included both federal and State funds. In various models, Skinner *et al*. did not find significance in the forester variables, stating that the data were not able to demonstrate the effect of technical assistance in NIPF tree planting. This study did find, however, that the amount of cost-sharing dollars spent influenced the amount of NIPF reforestation, indicating that, perhaps, increases in cost-sharing spending and additional associated technical assistance would increase NIPF reforestation. Although this model was not used in a predictive capacity to measure the impact of various scenarios on NIPF reforestation, a $1 million drop in cost share programs in 1985 would have resulted in an drop of 16,000 acres of reforestation according to Skinner's results.

II.2.3 Time series studies

DeSteiguer (1982) presented a model of non-cost shared investment in tree planting by NIPF landowners in the South to investigate concerns that cost-sharing substitutes for private investment. Using pooled cross-sectional time series data from 1964 to 1979, he modeled the dollars of non-cost shared NIPF investment against the funding levels of the FIP, ACP, the North Carolina, and the Mississippi tree planting programs summed together, as well as personal income levels, sawtimber stumpage prices, and the 10-year Treasury bill rate. The non-cost shared forestry investment, or autonomous investment variable was the sum of the private investment proportion of the cost of reforestation through the FIP and the ACP, the average per acre cost of reforestation based on FIP and ACP reports multiplied by the acres of reforestation not subsidized by the FIP or ACP, this minus the amount spent in State cost share programs. The non-cost shared acres reforested were found by subtracting the acres of FIP and ACP reforestation from the reported acres of total NIPF reforestation. Through the model estimation, which involved adjustments for auto-correlation, DeSteiguer found that for every dollar of government subsidy, an additional $0.35 of private capital is expended on reforestation, and this is in agreement with the data aggregate ratio of 1:0.36 for government to private dollars of investment.

Later DeSteiguer (1983) and DeSteiguer (1984) changed the report slightly so that a negative coefficient for the government expenditure variable with respect to the amount of non-cost shared private investment in tree planting would indicate landowners using government money for investment they would have undertaken with out monetary aid, also known as capital substitution. Using the same 16 observational periods as before, DeSteiguer found that government spending was insignificant at the 0.1 level, and thus concluded that no evidence of capital substitution exists. However, the way DeSteiguer set up the independent variable is curious, since the independent variable, autonomous forestry investment, includes money spent by landowners on their portion of reforestation under the FIP or ACP. A question arises over whether or not money spent by landowners in conjunction with the FIP or ACP is indeed autonomous investment. If the assumption is that this spending is autonomous, then we must conclude that landowners would have spent this money on reforestation anyway, and therefore we must assume that the programs have not induced any extra private investment. Otherwise, if these programs have induced private investment above levels that might have occurred without cost-sharing, the inclusion of this portion of private spending in the variable of non-cost shared investment is incorrect. In the latter case, the independent variable contains at least some induced investment through the FIP and ACP. Understanding that the FIP and

ACP funding levels were not significant in the model, we may conclude that these programs are not strong indicators of private investment levels in reforestation.

Cohen (1983) presented a slightly different model to investigate the same concerns, coming to the opposite conclusion of DeSteiguer. Cohen (1983) presented a structure for demand and supply of plantation forests. Landowner demand for plantations was assumed to be a function of expected stumpage price, the opportunity return from the best alternative investment, price of plantations, and the level of corporate forestry planting (Cohen, 1983). The supply function was assumed to be a function of plantation establishment cost, silvicultural practice costs, expected cost of risk factors, and the price of plantations (Cohen, 1983). Cohen bases an econometric model on these assumptions.

She modeled both total acres planted and acres planted without cost share assistance using annual time series data from 1964 to 1978. The model differed from DeSteiguer's since the FIP and ACP variables for examining the influence of cost-sharing were no longer the amounts spent on the programs but the acres reforested under those programs. Cohen's assumption was that if cost share substitution existed, the ACP and FIP planted acres would negatively impact on the acres reforested without assistance. Cohen was able to control for the influence in State cost share programs by including dummy variables for the presence of the Mississippi, North Carolina, Texas, and Virginia programs available during the latter portions of the 15 observation periods. Using ordinary least squares (OLS) regression, Cohen's models resulted in significance at the 0.02 level for the FIP and ACP. These coefficients in the model of non-cost shared acres planted were negative. Cohen concluded that these two programs had a negative impact on the number of acres reforested without government assistance, and therefore, through the FIP and ACP, private landowners were substituting cost share funding for their own investment. This is supported by the results of the model of total NIPF acres of reforestation, since the ACP and FIP have significant positive coefficients in these models.

Cohen estimated that 28 percent of the acres planted under the ACP would have been planted without the program. This is less than the 50 percent found by Yoho and James (1958). However, Cohen judged that overall, 40 to 50 percent of acres planted under cost-sharing programs would have been planted anyway.

Assuming that cost share programs substitute for private capital, Cohen wonders if landowners delay planting in order to receive cost share funding if there is not enough to finance their activities in the current year. In this manner Cohen suggests that cost share programs may have negative effects on NIPF tree planting as landowners hold off to receive subsidies later. Nodine (1993) found that two thirds of FIP participants experienced delays in the acceptance of their application, with 9 percent experiencing delays extending two years or more. The degree to which these landowners made the choice to delay reforestation in order to receive money, or had applied for the program and, having been approved, were waiting for those funds to arrive in before planting, is not known. The first case would support Cohen's concern. The latter would not.

Questions arise over Cohen's model estimation. The data Cohen used covered the same time period as DeSteiguer's data; however, Cohen's models did not compensate for auto-correlation. This correlation between error terms may arise in time series data (Maddala, 1988). Maddala (1988) states that time series models estimated by OLS can result in inefficient variance estimations, and any test for significance will be incorrect.

Brooks (1985) examined the effect of cost-sharing on the long-term timber supply in the South. Annual time series data were combined with an inventory model called the Southern Pine Age-class Timber Simulator (SPATS), and the Timber Assessment Market Model (TAMM). In this manner Brooks hoped to model the possible timber supply and price impacts of reforestation subsidies, a shortcoming in previous models.

The acreage of annual planting is a function of expected revenue, cost of establishment, and the amount of government payments. Brooks also mentions that other determinants are not quantifiable. Among those variables are: the landowner's feeling about replanting obligation, the desire of leave forests to heirs, and thoughts on the necessity of active reforestation (Brooks, 1985).

In the time series model, Brooks included government cost share payments for the ACP, CRP (Soil Bank), FIP, and other unspecified State programs over the 1950-1979 period. All program monies were summed together on the assumption that the provision and level of funds are more important than the program itself. This variable was included in the model as a series of annual lags from zero to four years. The Durbin-Watson test indicated that serial correlation was not a problem. It is not apparent, however, whether

Brooks considered the upper and lower bounds of the Durbin-Watson test. If not, then the Durbin-Watson test is inconclusive if the computed statistic lies between these two values (Maddala, 1988). Cost share expenditure and planting cost were significant variables in the model. These were the only two significant independent variables, the price data having been dropped because of high standard errors and unexpected coefficient signs.

Through Brooks (1985), the results show that an extra million dollars allocated to cost-sharing programs in the South will increase tree planting by around 9000 acres. However Brooks (1985) does not provide insight on where to allocate the money. Also the data do not include FRM dollars, and since this study has been published, the CRP, SIP, FSP, and various State funded programs have been created.

Alig (1986) utilized a pooled cross-sectional time series approach to investigate the factors and changes in Southern land use across three geographic regions. His model contrasted three forest and three non-forest classes using data from Forest Service surveys from 1947 to 1984 to analyze the percentage changes in land use with respect to changes in various policy, price, and demographic data. The effect of government cost share programs was examined by the sum of cost shares paid, though Alig does not list the programs included. He also includes dummy variables for the existence of the Virginia and North Carolina State cost share reforestation programs. In this system of models Alig found that, at the 0.05 level, government cost-sharing was significant in only three of the twelve models relating to forest use, while the Virginia dummy variable was significant in fifteen of twenty four models, and the North Carolina variable was significant in seven of twenty four models.

Neither Alig (1986) nor Brooks (1985) models are able to isolate the effects of individual programs on land conversion. For example, the FIP influences land use by hindering conversion from forest to crop or other uses, while the tree planting aspect of the ACP encourages the conversion from cropland to forestland. But Alig's approach could not estimate the relative influence of the two programs on conversion. A question arises since the ACP is not only a tree-planting program, but also helps to fund agricultural land use practices. While the funds included from the ACP in the forestry cost share funding variable may be specifically related to tree planting, there may be a conflict with this variable and the relative changes in land use, if higher levels of tree planting funding under the ACP are related to higher levels of ACP funding in general. The ACP helps to fund many agricultural practices; higher levels of ACP funding could also influence the conversion to agricultural uses, or at least hinder their conversion to other uses, such as forestry. How this interaction would play out in Alig's system of land use models is not certain, but may account for the low influence of tree planting cost share programs in this study.

Recognizing the quantitative shortcoming in prediction of such models, Hardie and Parks (1991) argued that up to that point, previous models did not capture changes that might be induced by a new policy. They proposed that only a model that simultaneously predicted landowner reforestation probability and replanting acreage response would provide the information necessary to make such inferences. They combined the same reforestation probability data as Royer (1985) and Royer (1987a) with the direct correspondence between the owner and acreage variables to simultaneously estimate both the landowner and acreage response. With this system of simultaneous estimations they predict the total acres reforested as a result of given economic incentives.

From their system of equations, Hardie and Parks analyze five different policy alternatives, which range from cancellation of tree planting subsidies, to 80 percent subsidization. The predicted acreage of tree planting resulting from these scenarios ranges from 0.3 to 2 million acres. These results seem to highlight the underlying limits of private reforestation in both extremes. The level of reforestation under the conditions of no subsidization provides some answer to the many earlier studies that debated levels of forestry investment without cost-sharing. The upper bound estimates the physical limit of reforestation in a single year. By comparing this figure with annual reforestation, the relative success of tree planting could be measured in regard to this possible maximum. However, such wide inferences may be beyond the level of variation underlying the model.

Whether the scope of the variations in data used by Hardie and Parks (1991) would allow for such scenarios is not explicit, neither is the form of the production function estimated. Results are reported for linear regressions, as such, the range of predictions is probably made on the assumption of a linear production function. Although constant returns to scale may be adequate over certain ranges of aggregate NIPF tree planting, it may not be representative of the full spectrum of a multidimensional production function. This would suggest that readers accept Hardie and Parks' results cautiously.

Hardie and Parks (1991) analyze variations in cost share subsidization rates and variations in program eligibility. From these variations they predict budget levels for the different scenarios that would be needed to meet the resulting demand. Rates of cost-sharing have generally been about 50 percent, varying little over the last fifty years. Under such conditions, the acres of NIPF tree planting have ranged between 0.1 and 1.5 million acres. Unlike Hardie and Parks' investigation, the structures of cost share programs have remained relatively stable, especially when compared to the levels of funding provided for those programs.

Lee *et al.* (1992) investigated the effects of the ACP, the FIP, the CRP, and the Soil Bank, on the acres of non-cost shared NIPF planting. This study utilized annual time series data from 1950 to 1988, with the independent federal program variables measured in acres planted. Their hypothesis was that a significant negative response in any of the four cost share program variables would indicate capital substitution, as defined by DeSteiguer (1982). They found the cost share variables FIP, ACP, and Soil Bank acres planted were not significant in the model, concluding that there is no evidence of capital substitution among any of the programs. The CRP was significant in the model with a positive coefficient. They concluded this to mean that either the CRP has induced private tree planting, or that the three years of CRP data were insufficient for estimation in the model.

Lee *et al.* utilize OLS to estimate the model for the 39 time periods. However, they do not provide any statistics to indicate they tested for auto-correlation, the presence of which invalidates tests of significance (Maddala, 1988). It is worthy to also note that the estimated coefficients for the FIP and ACP program were negative, though not significant in this case. These two things suggest that the approach of Lee *et al.* could be investigated further to establish their conclusions more definitively.

Lee *et al.* (1992) base their econometric model of tree planting on the method presented in Cohen (1983). They explain that suppliers of forests are those who combine the inputs of land, seedlings, labor, and machines to sell to those who demand forests (Lee *et al.*, 1992). Lee *et al.* explain that many times those who supply forests and those who demand forests are the same person. The price for which an established forest is exchanged in the market should be the expected return for the current and all future rotations of trees (Lee *et al.*, 1992). The supply model is a function of the price of the forest, the cost of inputs, and acreage of cost shared forests (Lee *et al.*, 1992). While the demand for forests is a function of the price of forests, and other factors, which are unspecified (Lee *et al.*, 1992). Lee *et al.* assume that supply must equal demand; therefore, the supply model and demand model are combined, canceling out the price of forests, and the remaining variables are equal to the annual quantity of acres planted. It is from the remaining variables, the cost of inputs, acreage of cost shared forests, and the unspecified influences on demand, that Lee *et al.* base their candidate variables.

Hardie and Parks (1996) revisited their simultaneous estimation of landowner reforestation choice and acreage response, using the same 1971 – 1981 data set as before while adding a landowner age variable. They again use five different model specifications to arrive at similar results to their previous work. They predict future levels of reforestation with cost share rates ranging from 0 to 100 percent in ten percent intervals.

Rudel and Fu (1996) published a model of reforestation rates based on social and demographic variables. Their objective was to investigate the theories of a group of sociologists known as the regionalists who worked in the South in the 1920 and 30's. Rudel and Fu's time series data, which covered the period 1933 to 1977, contained no variables of cost-sharing. Factors investigated were topography, climate, soil composition and depletion, agricultural farm type, illiteracy rates, industrial structure whether city, small town, or rural, and the size of the urban place. Rudel and Fu conclude that reforestation in the South can be explained by the process of urbanization, where farmers leave their land to get work in urban centers. However, they do not posit whether this reforestation is an active or passive process or some combination of the two. Land may revert to forest as a result of abandonment, or through planned regeneration and reforestation. The former process may have been prevalent during the great depression, at the earlier period of the data, while the latter may have been the main reforestation process at the later end. Despite this, the authors suggest that the indirect approach of fostering industrialization and urbanization may be used as a policy tool alongside more direct tools to increase reforestation. However, the relative effectiveness of these two approaches is not presented.

Most recently Kline *et al*. (2002) have revisited the work done by Lee *et al*. (1992), using the same time series data extended by 5 years and including a variable for harvested area. Kline *et al.* (2002) use the same system for supply and demand specification in their study. However, where Lee *et al*. (1992) modeled the acres of non-cost shared acres planted, Kline *et al*. (2002) model total acres planted to produce predicted tree planting acres for the next fifty years under several scenarios. They present an OLS model and a first order autoregressive model. The influence of cost-sharing is measured by the acres of tree planting by four programs, the ACP, CRP, FIP, and Soil Bank. In these models the FIP was not found significant. The authors posit that the FIP may indeed substitute for private capital, and support the findings of Cohen (1983).

II.2.4 Other studies

There have been several other studies with models related to reforestation and cost-sharing programs. Wallace and Silver (1983) compared four dependent variables with pre FIP (1971) to post FIP (1981) payments in Georgia. They found that the FIP was not significant in analyzing changes in standing volume, net annual growth, net annual growth plus removals, and removals, concluding that there was little indication that the FIP had any influence. However they said that they could not make a definitive study into the impact of the FIP, since the time frame had been too short, the FIP having only been in existence for seven years.

Boyd (1984) investigated the impact of the FIP on timber stand improvement and harvest decisions by NIPF landowners. His probit analysis found that the FIP dummy variable was not significant in the probability of harvest model, but was in the probability of stand improvement model.

Doolittle and Straka (1987) take a different approach to Southern landowner reforestation. They employ a “diffusion of innovation model” to explain the differences between landowners who regenerate following harvest to those who do not. Their conclusion was that landowners who were better educated, with higher social and economic standing, and participating in more organizations, scored higher on the scales of innovativeness and were more likely to actively reforest after harvest.

Mehmood and Zhang (1999) presented a logit model to analyze the probability of State cost share program existence. They surveyed of almost all the States in the U.S. and concluded that the political power of the forest industry coupled with a healthy State economy primarily determine the presence of State landowner assistance programs.

II.3 Summary

Studies and models of the individual landowner choice to reforest provide a complete picture about the relevant factors that influence active reforestation. Only through Skinner *et al.* (1990) and Brooks (1985) can policy makers interpret quantitatively what might happen if funding levels for cost-sharing programs change. Through Skinner *et al.* a $1 million drop would have resulted in a drop of 16,000 acres replanted in 1985, while through Brooks, a similar funding decrease would result in a drop of 9,000 acres. Though the effect of cost-sharing on NIPF landowners has been studied in many ways, no study has yet analyzed the effect of changing cost share program funding levels for tree planting. Policy makers remain uninformed about the impacts of their funding level decisions.

Chapter III. Methodology

III.1 Candidate variables

Candidate variables were selected as indicative of the factors influencing annual NIPF tree planting. The dependent variable is the annual number of acres of tree planting by NIPF landowners in the South. The perceived expected revenue from investment in tree planting is assumed to be a function of current stumpage prices, a proxy for expected future prices.

The price of land is implicit in the model. The land price is based on the prospective use, which reflects the present value of future income from either agriculture or forestry. As agricultural or forest commodity prices increase we would expect to see the value of land increase as a result. Thus the price of land is not specified in the model.

The price of labor, as an input in the model, is assumed to be captured in a planting cost variable. Though the labor component of planting cost is based on hired labor, it is assumed that few landowners replant using their own labor, or that the relative contribution of their own labor in the tree planting process is small. Capital inputs, such as machines and tools used for site preparation and planting are also assumed to a part of the planting cost variable. The funding levels of cost-sharing programs are proposed as candidate variables since they reduce labor and capital input costs. With more available funding, more landowners may be able to replant, and the greater the number of landowners that may be able to plant at lower cost.

Technical knowledge is captured in part by the cost of tree planting, since landowners who purchase the services of tree planting contractors also purchase the benefit of their planting expertise. Government funded technical assistance provides technical knowledge and is a candidate variable, since greater funding generates more public foresters who can assist landowners. Also funding for government assistance programs could enable landowners to hire consulting foresters. A measure of forest industry-run landowner assistance programs (LAPs) is another candidate variable that provides technical knowledge to NIPF landowners.

The returns from alternative land uses are represented by agricultural crop prices. Returns from alternative investments not associated with the land can be represented by

Treasury bond interest rates. A measure of income is also included in the list of candidate variables.

III.2 Statistical models

III.2.1 Time series models

Time series data, as presented in Appendix B, covers from 1956 to 1999 for the thirteen southern States, resulting in 45 observations. Maddala (1988) states that serial correlation between error terms often arises in time series data. These data can result in both biased and/or inefficient estimates, depending on the model structure (Maddala, 1988). Furthermore, tests of significance will be based on the wrong covariance matrix, and will be incorrect (Maddala, 1988). Therefore, we will need to examine models with serial correlation.

Through the seasonal nature of site preparation and tree planting, work reported as completed in any given year was commonly scheduled and cost shared with funds from prior years (Moulton, 1999). Nodine (1992) found that a reforestation delay is typically for one year. We hypothesized the need for a model with lagged variables. One approach is to lag all the cost share variables; another is to lag the dependent variable on the right hand side of the regression. In as much as the lagged dependent variable is a product of all the variables from the previous observation, the latter version is a simpler approach and avoids the cumbersome inclusion of many lagged variables. Thus the form of the proposed adjustment model is

$$y_t = \alpha + \beta \mathbf{X} + \delta y_{t-1} + \varepsilon_t$$

where y is the acres planted, t is an index of years from 1 to r, α is the constant term, β is the vector of coefficient estimates for the independent variables, **X** is a matrix of n independent variables by r years, δ is the estimated coefficient for the lagged dependent variable, y_{t-1} is the acres planted lagged by one year, and ε is the error term. In the time series model, the serial correlation in the error term ε_t is

$$\varepsilon_t = \rho \varepsilon_{t-1} + \eta_t$$

where ε_t is the error term in year t, ρ is the autocorrelation coefficient, ε_{t-1} is the error of the previous year, and η_t is the independent error value in year t.

Consistent and efficient estimates of the parameters above can be obtained through a two-stage process, which is equivalent to maximum likelihood estimation (Greene, 1997). Greene (1998) describes this process, originally presented by Hatanaka, by using instrumental variables to create estimates for [b,c], instrumental variables for y_{t-1} being the lagged value of the prediction of y_t from a regression of x_t and x_{t-1}. Estimate ρ by the autocorrelation of the residuals by the actual values of the variables, not the predictions. Then use the Cochrane-Orcutt transformation to do generalized least squares (GLS) based on the original data adding the regressor e_{t-1} to the model. The efficient estimate for ρ is now the original estimate plus the slope on the lagged residual in the previous regression.

III.2.2 Cross-sectional time series models

Cross-section time series data or panel data, as presented in Appendix C, covers ten southern States from 1979 to 1999 producing 210 observations. Greene (1997) notes the appropriate estimators for panel data are fixed or random effects models. These models untangle the timewise component from the effects across the States. Both models were estimated and the appropriate model chosen based on the results of a Hausman test, which tests for the orthogonality of the random effects and the regressors (Greene, 1997).

The fixed effects model assumes that the differences across States can be captured in the constant term (Greene, 1997). The model is estimated using Ordinary Least Squares (OLS) and is a system of simultaneously estimated equations, one for each State:

$$y_i = \alpha_i \mathbf{I} + \beta \mathbf{X}_i + \varepsilon_i$$

where y is the vector of acres planted by r years for each State, i is an index of States from 1 to s, **I** is an identity matrix, α is the value of the constant term for each State, $\mathbf{X}_i$ is the matrix of n independent variables by r years for each State, β is the vector of n independent variable coefficients, and ε is a vector of error terms by r years for each State.

The random effects model is used when the differences between States can be viewed as parametric shifts of the regression function (Greene, 1997). Generalized Least Squares (GLS) is used to estimate the model then becomes:

$$y_i = \alpha + \beta \mathbf{X}_i + u_i + \varepsilon_i$$

where α is the value of the constant term, u_i is an individual disturbance for eachState, in addition to the variables defined above.

Both the fixed and random effects models will more accurately assess the effects of cost share programs on the tree planting in the Southern States than the time series models, since they will not only capture the variation through time, but also capture variation across States. Similar to the time series model, we expect serial correlation to exist in the data; therefore, in the fixed and random effects models above, a first order autoregressive error term ε_{it} will be

$$\varepsilon_{it} = \rho \varepsilon_{i,\,t-1} + \eta_{it}$$

where ε_{it} is the error term for State i at time t, ρ is the autocorrelation coefficient, $\varepsilon_{i,t-1}$ is the error of the previous year for State i, and η_{it} is the independent error value for State i at time t.

Furthermore, a lagged dependent variable y_{t-1}, will be introduced for reasons explained in the time series model. Greene (1997) indicates that complications arise when this type of model is estimated, particularly in the random effects model, where the lagged variable is correlated with the compound disturbance in the model. Here, the time series model can serve as a benchmark with which to evaluate the fixed and random effects dynamic models.

III.3 Data

Annual data on acres of NIPF tree planting came from the USDA Forest Service (1986) and the *Tree Planters Notes*, a Forest Service publication (e.g. Moulton and Hernandez, 2000). Planting data from the former source includes acres of direct seeding. However in the *Tree Planters Notes,* direct seeding generally represents less than 0.2 percent of total NIPF tree planting. Therefore, it is assumed that direct seeding will have negligible impact on the regression calculations. NIPF planting data are missing for Tennessee in 1996, though tree planting in Tennessee is small and its loss from the aggregate time series data is likely to be negligible, it poses a problem for a cross-sectional time series and Tennessee was dropped from that model. The time series data are in Appendix B, while the cross-sectional time series data are in Appendix C. Data sources are listed at the end of each Appendix.

Three stumpage price series were considered: southern National Forests timber sales, Timber Mart South stumpage prices (Harris, 2001), and the Louisiana Timber Products Quarterly Market Report (Louisiana Department of Agriculture and Forestry, 2001), the latter two being based on NIPF timber sales. The USFS prices were not used, since they may not reflect NIPF stumpage prices, though they have been used by Brooks (1995), Lee *et al*. (1992), and Kline *et al*. (2002).

Timber Mart South prices are the most comprehensive for the South but are not available before 1979. This is the earliest year for which the cross-sectional time series model could be estimated. Unfortunately, data have not always been collected for Kentucky or Oklahoma, so these States were dropped from the cross-sectional time series model.

Using the Timber Mart South price series in the time series model would necessitate interpolation of the years prior to 1979, perhaps by correlation with another price series. Hancock Timber Resource Group (1999) took this approach in calculating expected rates of return for forest investment. Though they used the Timber Mart South price data, prior to 1979 they interpolated a Timber Mart South equivalent price from the Louisiana price series. When these two price series are modeled in a regression, the Louisiana series predicts 73 percent of the variation in the Timber Mart South price. However, the ability to accurately backcast an annual Timber Mart South equivalent price diminishes greatly the further back in time a point prediction is made. The prediction interval at the 95 percent confidence level is so large as to destroy any confidence in predicting any change in price from one period to another.

The Louisiana price series has been published every quarter since 1955. It is comprised of stumpage and log prices from five zones across Louisiana. Though it is limited in geographic scope, the continuous nature of the series is desirable in the model. The quarters of each year are averaged to create a calendar year series. The Louisiana prices were be considered representative series for the South, since they model at least 73 percent of the Timber Mart South variation. Cohen (1983) used the Louisiana price series in a time series model of Southern NIPF planting for the 1964 to 1978 period. This series was found significant at the 2 percent level, demonstrating that the series is indicative of general price trends and variation in the South (Cohen, 1983). The pulpwood and sawtimber stumpage prices from the Louisiana price series will be included in the time series model.

Forest Landowner contains the only published average planting cost data for the South over time. These data have been published every two to seven years in the past, back to 1952, from information collected over the calendar year (Dubois *et al*., 2001). The problem of missing years must be overcome if these data are to be used.

Brooks (1985) created an annual planting cost series using the previous data by interpolating the missing years and then weighting the annual data in an index of total cost. This index included planting, site preparation, and seedling costs, and extended from 1950 to 1979. Lee *et al*. (1992) updated this series for use in their tree planting model, and was further updated to 1997 by Kline *et al*. (2002), although the seedling cost component was dropped due to the lack of data. This series has been obtained and extended to cover up to 2000 in nominal terms using the most recent cost survey data from Dubois *et al*. (2001).

The funding levels of the FIP are available through accomplishment reports published annually. Unfortunately no reports exist for the 1975 and 1976 years (USDA ASCS, 1978) and are missing data points in the model. Until 1995, FIP reports have contained breakdowns on how the FIP funds were spent by State and by activity type, whether tree planting, timber stand improvement (TSI), or site preparation for natural regeneration. Since the FIP changed management authority in 1996, breakdowns of funds spent by State and by activity have been unavailable. FIP data from 1996 to the present have been provided by the NRCS. The FIP series must include the TSI component if it is to extend up to the present. Since the recent drop in FIP funding is a concern and prediction of future policy scenarios is desired, funding levels for the FIP that include the TSI component are used. In the South, the TSI component of FIP spending has generally been around 6 to 7 percent, and it is assumed that variations in TSI funding will have a negligible impact on the regression calculations.

Data on ACP funds spent on tree planting are available through annual accomplishment reports. Data are broken down by State and by each major activity. Along with the program name changes in the early 1970's, the reports have been published in various titles, this combined with their scarcity, made it difficult to locate every report.

CRP data have been provided by the USDA Farm Service Agency in spreadsheet form. The spreadsheet data contain the amount spent on cost-sharing for forest establishment as well as the annual CRP rental payment.

Soil Bank data are published in annual accomplishment reports that break information down by State and by activity. From these reports a Soil Bank data series has been built for the money spent on the tree planting for the forestry purposes component of the program.

Annual SIP accomplishment reports contain data similar to the annual accomplishment reports of the FIP, ACP, and Soil Bank. Information is broken down by State and activity. From the State breakdowns, a SIP series has been obtained for the amount spent on tree planting activities for forestry purposes.

FSP funds spent in the South were collected from records at the Forest Service offices in Atlanta. These data also cover the Southern region as a whole and can only be used in south wide aggregate time series regression models.

FRM funding data for the South were pieced together using a variety of internal forestry service reports and accounting papers. Reports included the Forest Service Explanatory Notes, Field Allotment reports, and the Chiefs Program and Work Planning Advice reports among others. Some data were available by State and others only by

Forest Service region; therefore, like the FSP information, the FRM data were only utilized in the time series regression model. Also, the 1978 data point was not available and was forecast based on the 12 previous data points.

Funding for State cost-sharing programs was obtained by directly contacting each State forestry department. Timber stand improvement cost-sharing was removed from the data.

Cost-sharing fund levels for tree planting were analyzed separately as individual programs, in groups that primarily influence afforestation of marginal farmland (ACP, CRP, Soil Bank) and reforestation of cutover land (FIP, FRM, FSP, SIP, and State programs), or summed in total. These cost-sharing data forms are referred to in the individual cost-sharing program model, the grouped cost-sharing program model, and the total cost-sharing model respectively.

Representative data about the forest industries' commitment to landowners assistance programs (LAPs) back to the 1950's are not available. The enormity of accurately quantifying the impact of industry foresters on NIPF management over the last 50 years is beyond the scope of this study.

The 10-year Treasury bond rate was considered to be a proxy variable for the landowner's next best choice of investment that is not directly associated with the land. Although, Cohen (1983) found interest rate not significant, DeSteiguer (1982) and Lee *et al.* (1992) concluded that it was. The nominal 10-year T-bill interest rate was used in the time series model only.

As a variable indicative of the alternative income available through the use of land in agriculture, Cohen (1983) used an index of soy and corn prices. Although national corn prices are readily available through the National Agriculture Statistics Service back to the 1950's, soybean prices were not found over this time period. This corn price is a nationwide average and was used in the time series model only. It is hypothesized that the national corn price will reflect the prices of most agricultural products and substitutes for forestry land use. In a simple example, a change in corn price may affect grain-fed beef prices, which in turn will be reflected in the price for beef fed on hay or grass. Through this example the price of corn can influence the agricultural use of land even when the land is not directly suitable for planting corn.

Average income of all, or even a representative sample of Southern NIPF landowners over time is not known. The education level of NIPF landowners is a variable that might be used as a substitute, however this information is also unavailable. Average annual per capita personal income over time for the South and by State is available from the Bureau of Economic Analysis (BEA) and was included in the time series and cross-sectional time series models. It is assumed that these average data will capture the changes in income levels of NIPF landowners. Finally, the all items consumer price index was used to transform the nominal dollar value data to real dollar data.

Chapter IV. Estimation results

IV.1 Time series model

The results of the time series model are presented in Table 1. The total cost-sharing model and individual cost-sharing program model were estimated by two stage least squares (e.g., see Greene 1997, Greene 1998). The grouped cost-sharing program model represents an OLS model. A Goldfeld-Quandt test for heteroskedasticity, where the data for the total cost-sharing model were split in half, resulted in a GQ test statistic of 0.586, which was not significant. We did not reject the null hypothesis that there is no difference between the variance of the two halves. A unit root test, or Dickey-Fuller test, on the data for the total cost-sharing model resulted in a test statistic u = 15.41. Therefore, we rejected the hypothesis that data are a difference stationary process and we could evaluate data in their current form as levels.

IV.1.1 Total cost-sharing model

The model of NIPF tree planting, where all the government cost-sharing funding levels are summed to create one variable, total cost-sharing, resulted in 39 observations after the missing variables were rejected and a Cochrane-Orcutt transformation performed. Since the Durbin-h test value was 3.51 we rejected the hypothesis that there is no serial correlation and evaluated the model using two stage least squares, here the lagged dependent variable was instrumental prior to estimation. The value of the F-

statistic is 29.19, indicating that the two-stage regression was significant. Both the total cost-sharing funding variable and the lagged acres planting variable were significant at the 10 percent level and smaller.

Table 1: Time series model coefficient results

Explanatory Variable	Total cost shares model	Grouped cost shares model[1]	Individual program cost shares model[2]
Constant	120406 (449209)	-366997 (314948)	-172775 (326589)
Lagged planting	0.282839* (0.154941)	0.255935*** (0.083771)	0.366326*** (0.099152)
Income	25.6429 (19.6512)	74.7011*** (15.8735)	51.6844 (37.9596)
Cost of tree planting index	-5369.91 (6007.00)	-8110.87** (3403.64)	-6288.76 (5276.55)
Sawtimber price	-683.848 (616.003)	671.901 (485.727)	365.949 (527.954)
Pulpwood price	13396.9 (22556.8)	1258.21 (15579.4)	8351.47 (17234.7)
Corn price	-18582.5 (38521.8)	18554.5 (27654.0)	9904.33 (29255.6)
T-bill rate	-14669.9 (12130.3)	16971.8* (9731.86)	9609.03 (11433.5)
Total cost shares	0.020812*** (0.004378)		
Afforestation group funding		0.029677*** (0.003969)	
Reforestation group funding		-0.007958 (0.003367)	
ACP funding			0.000659 (0.013541)
CRP funding			0.026051*** (0.004907)
FIP funding			-0.008781 (0.006679)
FRM funding			-0.009800 (0.022180)
FSP funding			-0.027631 (0.027778)
SIP funding			0.011403 (0.035770)
Soil Bank funding			0.039286*** (0.005991)
State program funding			0.007282 (0.033694)
Observations	39	42	39
Log-likelihood	-552.770	-594.752	-552.770
F-Statistic	29.19	67.96	35.38
Rho	0.38213	-0.03501	-0.40127

Notes: Standard errors are in parentheses.
* significance at the 10% level, ** significance at the 5% level, *** significance at the 1% level.

[1] Cost-sharing grouped by afforestation of farmland and reforestation of cutover land

[2] Cost-sharing separated by eight programs, with State program funding the aggregation of six State programs

The total cost-sharing coefficient is positive and significant at the 1 percent level, supporting the view that the funding levels of government cost-sharing programs help landowners to plant trees on their land. This result is consistent with the findings of Brooks (1985) and Skinner (1990). The lagged dependent variable, acres planted, is also significant, which indicates that the levels of the independent variables from the previous period, particularly the previous year's cost share-funding, influence the level of NIPF tree planting in the current year, as was hypothesized.

The variables that are not significant, but which carry the expected signs for the coefficients are pulpwood stumpage price, corn price, tree planting cost, average personal income, and the T-bill rate. The sawtimber stumpage price coefficient was negative but not significant.

IV.1.2 Grouped cost-sharing program model

The time series model of the acres of trees planted where the government subsidy variables are summed together according to their influence toward reforestation after harvest, or afforestation on cropland, results in 42 observations after missing variables are removed. The Durbin-h test for serial correlation with the presence of a lagged dependent variable could not reject the hypothesis that there was no autocorrelation with h = -0.27, and the model was estimated using OLS. The model F statistic was 67.96 showing that the regression was highly significant. The afforestation group cost share variable, average personal income, cost of tree planting, T-bill rate, and lagged acres planted variables were all significant in the model at the 10 percent level and smaller.

The farmland afforestation cost share group variable was positive and significant at the 1 percent level and indicates the importance of this form of cost-sharing, particularly at the marginal interface between agricultural and forestry land use. Owners of marginal cropland may be willing to convert to forestry given the right incentives. This finding is similar to the results of Lee *et al.* (1992) and Kline *et al.* (2002). The coefficient for average personal income is positive and significant at the 1 percent level, a result consistent with many studies (DeSteiguer, 1982; Cohen, 1983; Alig, 1986; Romm *et al.*, 1987, among others). This significant result suggests that landowners may be unwilling to borrow money or financial institutions are unwilling to lend capital to finance tree planting, and/or landowners derive amenity values from forestland. The tree planting cost coefficient is negative and significant at the 1 percent level, showing that as planting cost increases, landowners tend to plant less (see also Brooks, 1985; Lee *et al.*, 1992; Kline *et al*, 2002). The coefficient for the 10-year T-bill rate was found positive and significant at the 10 percent level. The positive result is counter intuitive. This result may indicate a process a little more complicated than T-bill rates being an alternative investment for landowners' capital. It may be that landowners invest in forestry when inflation rates are high, because higher inflation boosts T-bill rates. Landowners may plant trees as a hedge against inflation. The lagged planting coefficient is positive and significant at the 1 percent level again indicating that the levels of the independent variables in the previous period have a carryover effect, influencing the tree planting effort in the next year.

The sawtimber and pulpwood stumpage price coefficients both have the expected positive coefficient signs but are not significant. The funding level of the cutover land reforestation group variable was negative and not significant. Although the sign of the coefficient was not expected, this has been the result in other studies (Cohen, 1983; Kline *et al.*, 2002). Given the highly significant result of the farmland afforestation group variable, the result of the cutover land reforestation group variable indicates that these programs are not influential on tree planting. This result may be one reason why Kline *et al.* (2002) find forest harvest significant since landowners generally replant after harvest. These results support Cohen (1983) and Kline *et al.* (2002) who conclude that cutover land reforestation subsidies simply replace private capital. The corn price coefficient has a counter-intuitive positive sign and is not significant.

IV.1.3 Individual cost-sharing program model

The time series model where each cost share program is entered separately, resulted in 39 observations after missing variables were omitted and a Cochrane-Orcutt transformation carried out. The OLS Durbin-h value was –2.26 and the null hypothesis that there is no serial correlation was rejected at the 5 percent level. The model was estimated as a lagged dependent variable model with autocorrelation by two-stage least squares. The model F-statistic was 35.38 showing that the regression was significant.

Variables which where significant at the 10 percent level and smaller were the CRP program, the Soil Bank Program, and the lagged planting variable.

Both the CRP and Soil Bank program variables were significant at the 1 percent level. This result formalizes the thought that the high funding levels for these programs, in the late 1950s and the mid-1980s respectively, resulted in the two large spikes in NIPF tree planting as seen in figure 1. This result is similar to the finding of Kline *et al.* (2002) and is not surprising given that the intent of these programs was to plant trees on cropland and remove them from agricultural production. The coefficient of lagged planting was positive and significant at the 1 percent level as it has been in the previous two models.

The SIP and ACP funding coefficients are positive though not significant. Both the ACP and the SIP are directed at environmental and conservation goals, the ACP on the agricultural side and the SIP on the forestry side. The State cost-sharing funding, average personal income variable, and sawtimber and pulpwood stumpage variables are positive and not significant. The tree planting cost coefficient is negative and not significant.

Both the corn price and T-bill rate coefficients are positive but not significant. The FIP, FSP, and FRM funding variable coefficients are negative and not significant, a result similar to Cohen (1983) and Kline *et al.* (2002). The FIP is directed toward reforesting after harvest, usually for commercial intent. The FRM program, in part, supports the activities of State forestry agencies in a wide variety of roles, the funding level of this program, in total, may have little influence on NIPF tree planting, despite the technical assistance, seed and seedlings that it provides to NIPF landowners. The funding level of the FSP, which provides for the creation of landowner forest management plans does not seem to influence the immediate level of NIPF tree planting. However, since the FSP produces management plans for standing forests and is associated with the SIP, the program may influence regeneration practices in the future.

IV.2 Cross-sectional time series models

The results for the cross-sectional time series models are presented in Table 2. Two stage least squares models were carried out to determine the merits of whether cost share program budgets were endogenous in the models, based on the thought that funding levels may be set with specific levels of tree planting in mind. However, these models did not predict the hypothesized endogenous variables well, and all variables were assumed to be exogenous.

IV.2.1 Total cost-sharing model

Both the fixed effects and random effects model were estimated with 200 observations after a Cochrane-Orcutt transformation. The F statistic calculated for the fixed effects model at 42.10 showed that the regression was significant. The Hausman test statistic was 0.63, which shows that the random effects model is favored over the fixed effects model. The significant variables for the random effects model at the 10 percent level and less were total cost shares, average personal income, sawtimber stumpage price, and lagged acres planted.

The coefficient of total cost shares paid was significant at the 1 percent level and adds a greater level of detail to the effects of cost-sharing previously found in the time series model. Total cost-sharing spent in each State plays a significant role in the annual levels of tree planting. The average personal income coefficient was also found to be positive and significant at the 1 percent level suggesting that higher income results in greater tree planting efforts in each of the Southern States included. The coefficient of sawtimber stumpage is positive and significant at the 10 percent level, a finding that corroborates the results of Hardie and Parks (1991). The lagged acres planted coefficient is also positive and significant at the 1 percent level, the effects of the previous years independent variables spilling over to the next year. The pulpwood price coefficient was negative and not significant in the model, a similar result to Hardie and Parks (1991).

Table 2: Cross-sectional time series model coefficient results

Explanatory Variable	Total cost shares model	Grouped cost shares model[1]	Individual program cost shares model[2]
Constant	-96540.0***	-64890.1**	-45391.2
	(27552.6)	(27995.9)	(36939.3)
Lagged planting	0.317535***	0.288052***	0.237155***
	(0.058044)	(0.056526)	(0.063648)
Income	8.18583***	7.03342***	6.89234***
	(2.00872)	(1.99341)	(2.60971)
Sawtimber price	126.232*	150.243**	130.181
	(76.2302)	(74.0353)	(82.9040)
Pulpwood price	-232.896	-290.122	-696.328
	(775.912)	(757.528)	(820.698)
Total cost shares	0.019922***		
	(0.002621)		
Afforestation group funding		0.025179***	
		(0.002847)	
Reforestation group funding		0.003705	
		(0.004693)	
ACP funding			0.021564*
			(0.011505)
CRP funding			0.024395***
			(0.003149)
FIP funding			-0.005165
			(0.008029)
SIP funding			-0.002503
			(0.028825)
State program funding			0.007598
			(0.006862)
Log likelihood	n/a	n/a	n/a
F-statistic	n/a	n/a	n/a
Rho	0.358624	0.358624	0.358624
Lagrange multiplier test	5.48	5.84	9.60
Hausman test	0.32	0.74	0.63

Notes: Standard errors are in parentheses.
* significance at the 10% level, ** significance at the 5% level, *** significance at the 1% level.
[1] Cost-sharing grouped by afforestation of farmland and reforestation of cutover land
[2] Cost-sharing separated by eight programs, with State program funding the aggregation of six State programs

IV.2.2 Grouped cost-sharing program model

The model where cost share funding was grouped into either programs that encourage farmland afforestation or programs that encourage cutover land reforestation had 200 observations after a Cochrane-Orcutt transformation. The regression resulted in a F statistic for the fixed effects model of 43.51 showing that the regression was significant. The Hausman test statistic was 0.74, again favoring the random effects model. The random effects model regression resulted in the following significant variables at the 10 percent level and less: afforestation cost shares group, average personal income, sawtimber stumpage price, and lagged acres planted.

The coefficient for the afforestation cost shares group was positive and significant at the 1 percent level. This result elucidates the significant component of the total cost shares variable above and suggests, as do the time series model results, that funding levels of programs which influence the conversion of agricultural land to forest greatly affect tree planting efforts on private land. The coefficient for average personal income by State is also positive and significant at the 1 percent level along with the coefficient for lagged acres planted. The sawtimber stumpage price coefficient is significant at the 5 percent level and supports the hypothesis that NIPF landowners respond to market forces. In this model the pulpwood stumpage price coefficient is negative and not significant, as it is in the model above.

IV.2.3 Individual cost-sharing program model

This model, which enters each cost share program separately, has 200 observations after a Cochrane-Orcutt transformation. The fixed effect regression resulted in a significant F statistic of 36.14. The Hausman test statistic was 0.32 signifying that the random effects model should be used. When the random effects model was calculated, four variables were significant at the 10 percent level and less: CRP funding, ACP funding, average State personal income, and lagged acres planted.

The coefficient of CRP funding level in each State was positive and significant at the 1 percent level. This mirrors the result in the time series model above, at an increased level of detail. The coefficient of ACP funding in each State is positive and significant at the 10 percent level, a result that did not come out of the equivalent time series model, but was found significant in Cohen (1983) and Kline *et al.* (2002). The funding level of the ACP was influential in the number of acres of tree planting in the South. The average personal income in each State is significant at the 1 percent level as it has been found in the total and grouped cost shares cross-sectional time series models. The lagged acres planted coefficient is also significant at the 1 percent level as is has been in all the regression models.

The coefficient of State cost-sharing is positive albeit not significant, as is the sawtimber stumpage price. However, the FIP funding coefficient is negative and not significant as it was when data were aggregated in the time series model. The pulpwood stumpage price and SIP funding coefficient is also negative and not significant.

IV.3 Elasticities

IV.3.1 Time series elasticities

The elasticities of each significant variable from the results reveals the percentage change in annual tree planting with a 1 percent change in the level of the significant variable. A 1 percent change in total cost share funding results in a 0.59 percent change in tree planting. While the same marginal change in farmland afforestation funding results in a 0.32 percent change in tree planting. The elasticities for the CRP and Soil Bank are not presented because they do not extend over a significant number of data periods. With the exception of average personal income, all the significant variables are less than one or inelastic. The elasticities of planting for significant variables in the time series models are presented in Table 3.

Table 3: Elasticities of planting from the time series models

Model	**Variable**	**Elasticity**
Total		
	Total funding	0.59
Grouped		
	Income	1.26
	Cost of planting index	0.56
	T-bill rate	0.19
	Afforestation group funding	0.32

IV.3.2 Cross-sectional time series elasticities

The elasticities from the cross-sectional time series models demonstrate the percent effect on tree planting with a 1 percent change in the significant independent variable within each State. While the average elasticity results are similar to the elasticities for the aggregate time series model, individual State elasticities reveal the differences between States, which is not otherwise apparent. This information can be used to target States where policy changes will have the greatest impact. Total funding elasticity varies between 0.88 for North Carolina and 0.28 in Georgia. Elasticity for cropland afforestation varies between 0.27 in Alabama and 0.04 in Texas. While CRP funding elasticity ranges between 0.18 in Arkansas to 0.02 in Texas and Virginia. The cost-sharing elasticity of planting tends to be lower in States where there is relatively little annual funding compared the amount of annual reforestation.

Sawtimber elasticity reveals that a 1 percent change in sawtimber price will have the greatest effect in Texas with a 0.78 percent change in reforestation, while only a 0.13 percent change in Georgia. The income elasticities demonstrate that in some States the effect is very elastic, such as Texas and Louisiana, while in others it is inelastic, such as Mississippi and Georgia. As the economy grows and personal income raises in these states we can expect that tree planting will expand in Texas and Louisiana more than it will in Georgia and Mississippi, other things equal. The elasticities of planting for the significant variables for the cross-sectional time series models are presented in Table 4.

Table 4: Elasticities of planting from the cross-sectional time series models

Model	**Variable**	**State**										
		AL	AK	FL	GA	LA	MS	NC	SC	TX	VA	Average
Total												
	Total funding	0.46	0.46	0.39	0.28	0.52	0.59	0.88	0.46	0.55	0.48	0.51
	Income	0.90	3.15	1.69	0.55	3.36	0.64	1.42	1.26	3.65	1.88	1.85
Grouped												
	Income	0.77	2.08	1.45	0.47	2.89	0.55	1.34	1.09	3.13	1.62	1.54
	Sawtimber price	0.23	0.60	0.32	0.13	0.81	0.19	0.29	0.31	0.78	0.24	0.39
	Afforestation group funding	0.27	0.21	0.21	0.21	0.19	0.20	0.06	0.20	0.04	0.07	0.17
Individual												
	Income	0.75	2.04	1.42	0.46	2.83	0.54	1.31	1.06	3.07	1.59	1.51
	CRP funding	0.13	0.18	0.05	0.11	0.15	0.15	0.04	0.07	0.02	0.02	0.09
	ACP funding	0.00	0.02	0.00	0.01	0.01	0.01	0.02	0.00	0.02	0.01	0.01

Chapter V. Discussion of results

V.1 Cutover land reforestation cost-sharing programs

The funding levels of programs that cost share reforestation on cutover lands were not significant in the models evaluated. This result is surprising given the number of forested acres these programs cost shared. However, this result is supported by the findings of Cohen (1983) and Kline *et al.* (2002) who found that the FIP was not significant in their models. Both concluded that the FIP is ineffective, yet the fact remains that through the FIP, 3.8 million acres of trees have been planted. How could such a program, as well as others, have no effect on NIPF reforestation when analyzed econometrically?

Other much larger programs may have masked the influence of the FIP. However, when the five States that received the most FIP money were entered into a random effects model alone, the results remained the same. Each of these States had received more than $20 million from the FIP. The FIP's influence might have been obscured by NIPF landowners' reactions to stronger market influences. But stumpage prices and planting costs did not elicit strong changes in reforestation behavior in the models analyzed. These parameters would also affect all programs, not just those for reforestation.

Another reason for the insignificant cutover land reforestation coefficients might be that the reforestation programs target those landowners who would normally reforest after harvest anyway. Studies have shown that most users of cutover land cost-sharing programs are landowners who have a commercial interests in forestry, are better educated, and have higher incomes, characteristics that would suggest they might replant without subsidies. Also reforestation cost-sharing programs might not be influential because there is little land being converted from forestry to agriculture. These programs might be effective in periods when significant amounts of forest land are being converted to agricultural use. However, this is not the case. Since the reforestation programs, like the FIP and the SIP, were not significant, the model cannot predict the effect of reducing funding for these programs. The effect may be negligible.

V.2 Farmland afforestation cost-sharing programs

The afforestation cost share group variable was significant in both the time series and the cross-sectional time series models. Each individual farmland afforestation cost share program was significant in at least one of the two models. This finding is noteworthy given that no cutover land reforestation program variable was found significant. The farmland afforestation programs are the most influential cost share programs and presently, of those analyzed, only the CRP remains in operation. Why were these programs so influential in the econometric analysis? The large spikes in NIPF tree planting in the late 1950s and mid 1980s correspond, respectively, with large Soil Bank and CRP funding levels. The econometric analysis showed the correlation between these events.

The afforestation programs may be quite influential at encouraging individual landowners to plant trees on marginal cropland. At the margin between agriculture and forestry, the afforestation programs, especially those with annual rental payments, may be particularly effective at tipping the scales in favor of forestry. If the assumptions of neoclassical economics held, and if timber production is indeed more profitable on marginal cropland than agriculture, we might expect the transition from agriculture to forestland to proceed easily and the effect of the afforestation programs might not be as great. However, since the results show income is significant and indicate that either landowners are unwilling to borrow, and/or banks are unwilling to finance tree-planting activities, this may impede the shift from agriculture to forestry as the margin changes. Landowners may leave marginal land idle rather than convert to forestry if they are unwilling or unable to obtain financing to plant trees, even when acceptable returns on forest investment could be made. This idea is supported by the large amount of marginal agricultural land that could earn greater returns if converted to forestry (USDA Forest Service, 1989). If landowners, and particularly farmers, are truly profit-maximizing producers, we would not observe idle land unless farmers are not as optimistic or uncertain about the financial returns from forestry as the *South's Fourth Forest* (USDA Forest Service, 1989), or there are investment impediments.

Interestingly, we do not observe other individuals buying up marginal land and planting trees as we might expect if only farmers faced investment barriers and/or uncertain returns. Therefore, we could expect that individuals in general face these concerns. We may also observe idle agricultural land that could earn higher returns in trees if there is an amenity value for maintaining the family farm. In these cases, the cost-sharing and rental payment money may be enough for some farmers to forgo the family farm amenity value, at least on some of their property, or to overcome financial constraints and uncertainties, and plant trees.

The lower the funding for farmland afforestation cost-sharing, the less acres are likely to be afforested. The time series and cross-sectional time series models predict that a one-time Southwide reduction of afforestation subsidies by $1 million in 1999 dollars would result in around 15,000 to 18,000 less acres planted that year, holding all other variables constant. Since not all funds appropriated in a given year are used and often fund tree planting in the following year, there is a carry-over effect of this funding reduction. The carry-over effect, manifested in the model through the lagged dependent variable, is estimated to be 26 to 29 percent of the previous year’s planting in the grouped cost-sharing models. Therefore, the total decline in tree planting from a $1 million funding reduction would be around 19,000 to 23,000 acres, or roughly 21,000 acres over a two-year period. If the funding reduction remained in effect annual planting would remain approximately 21,000 acres lower.

The results show that the cost-sharing elasticity of acres afforested is less than one. A one percent reduction in funding for all afforestation programs would result in a 0.32 to 0.17 percent reduction in tree planting. Individual program elasticities presented by State reflect the relative ratio of tree planting to the amount of funds spent in that State. States that have lower a elasticity of planting generally have a low ratio of cost share funding to tree planting acres. This does not indicate that cost-sharing programs are less efficient in these States.

This analysis has found a significant difference between the influence of cutover land reforestation programs and marginal farmland afforestation programs on the level of tree planting in the South. Afforestation programs are influential, while reforestation programs are not.

V.3 Personal income

The average personal income variable was significant in four of the six models. The significance of this variable suggests that private landowners may be unwilling to borrow money, financial institutions may be unwilling to lend financial capital to plant trees and most landowners must fund tree planting activities out of their own pocket, and/or landowners derive amenity benefits from forestland. An alternative to this scenario might be that landowners are utility maximizers who invest so as to spread out their income over their life. As their income increases, they not only consume more in the current period, but they also invest more to enjoy a higher level of consumption in future periods.

Income may be more critical in deciding to plant on marginal farmland than in reforesting land after harvest. Landowners who reforest after have timber sale income to pay for the costs of tree planting. However, farmers with marginal cropland, who generate a steady income based on their land, might find it harder to pay for tree planting on their less productive, or abandoned fields. This thought suggests a structural difference between the decision to replant after harvest and to plant on marginal cropland. Where annual tree planting figures could be broken down between the two types of tree planting, this idea could be investigated.

The estimated income elasticity of planting is generally greater than one. A one percent change in average personal income results in an estimated change in tree planting of 1.26 to 1.85 percent on average across the South. The random effects cross-sectional time series model found that income elasticity was very high in Texas, Louisiana, and Arkansas, while it was below one in Alabama, Mississippi, and Georgia. The contiguous nature of each group of States is noteworthy. Although tree planting is income elastic, it would be a questionable policy to increase average personal income in order to increase tree planting. However, the results show that as the economy grows and personal income increases we would expect to see tree planting increase, other things equal.

V.4 The carry-over effect

Lagged tree planting was considered to be the carry-over effect of the independent variables and was significant in all of the models analyzed. The sign of the coefficient of this variable was positive and ranged between 0.24 and 0.37, thus a portion of the following year's tree planting will equal to between 24 and 37 percent of tree planting in the current year. Since the coefficient is less than one the variable is meaningful, the effect of previous years tree planting fades geometrically. If the coefficient were greater than one, the equation system would be meaningless since tree planting would increase in a multiplicative fashion.

This variable was included to model the carry-over effect of previous years' cost share funding levels. Cost share recipients are often subsidized from funds appropriated in prior years. This could arise since not all cost share funding is used in a given year and the remaining money is carried over to the next year, or cost-sharing is approved and money is allocated but the planting carried out the following season and the money is paid at that time. In this manner the current cost share funding level not only effect the current year but also has an effect in subsequent years, thus any policy change will have a carry-over effect in the following years declining geometrically. This carry over effect only pertains to the CRP since it is the only cost-sharing program in existence that was significant in the analysis.

V.5 Market influences

Tree planting cost, sawtimber and pulpwood stumpage prices, corn prices, and Treasury bond interest rates were included in the analysis to measure the market influence on tree planting decisions. The analysis found that only tree planting costs and sawtimber prices were significant and resulted in the expected sign in any of the six models.

The results show that landowners react negatively to increases in planting cost by reducing the acres they plant in trees. For every dollar increase (1999 dollars) in planting cost Southern landowners, in aggregate, plant 4,800 acres less than they would have, had there been no cost increase. Cost-sharing programs on cutover-lands are designed to reduce the cost of tree planting yet the study finds that these programs have no effect. This result could mean cost-sharing money from reforestation programs is received too late to have an effect. Poorer landowners may be unable to finance tree planting from their own pocket even though they may be assured of receiving a cost-sharing check some time later because they require their income to cover living expenses now. Wealthier landowners may be in a better position to deal with a delay in receiving funds. However, these landowners have received a potentially large amount of money from their harvested timber, the significant negative result of tree planting costs may pertain more to farmland afforestation decisions in this study. Separate reforestation and afforestation data are required to fully understand the effect of changes in tree planting cost and their relevance to cost-sharing programs.

From the cross-sectional time series model, a dollar increase in the real price of sawtimber results in a particular State results in landowners planting about 126 to 150 acres more than they would have had there been no price increase. A one-dollar increase (1999 dollars) in sawtimber prices across the South would result in 750 to 900 extra acres planted. Landowners' reactions to increases in sawtimber stumpage price rather than pulpwood stumpage price might be because real pulpwood prices have remained constant over time and are expected to continue to remain constant in the future even though there may have been a price increase in the present year. Thus landowners do not react to a pulpwood price increase since they expect it to last only for the present period, and expect the price to remain at the same historic constant level in the future. On the other hand, real sawtimber prices have increased over time, and given the uncertainty of sawtimber prices in the future, a price increase in the current year might increase the expected future price and thus the expected returns. Landowners then react to this expected increase by planting more trees.

Chapter VI. Summary

NIPF reforestation has been low and considered a problem in the past by some authors. Cost-sharing subsidies for landowners to plant trees have been viewed as a means to mitigate the perceived problem. In the past, most of these subsidies have gone to Southern landowners. Some wonder about the effects of recent cuts in cost share funding on the sustainability of tree planting on the South.

While previous studies show that cost-sharing programs are important, few can be used to quantify any effect of funding reductions, having considered the effects of all types of cost-sharing equal, irrelevant of the program from which the assistance came. Policy makers lacked relevant information needed to make decisions about the future of cost-sharing programs.

Candidate variables were selected and data were gathered for use in econometric analysis to model the acres of NIPF tree planting in the South over time and across States. This study finds that the funding levels of cost share programs that are designed to encourage landowners to plant trees on idle or marginal farmland are very influential in the number of acres planted in the South. Cuts in CRP funding, the only remaining program of this type, will result in lower levels of tree planting in the South. A cut of $1 million, in 1999 dollars, would reduce tree planting by approximately 21,000 acres over three years, other things equal.

The funding levels of programs that encourage landowners to replant trees after harvest do not influence the acres of trees planted in the South. Cuts in the funding levels of the FIP, SIP, FSP, FRM, and State programs may not have any aggregate effect on the acres of trees planted. This finding was verified even when the States that received the largest amounts of FIP cost share funding were analyzed separately.

Average per capita personal income in the South was positively correlated with acres planted, suggesting that landowners may lack the capital for tree planting. This is most relevant for landowners planting trees on marginal farmland rather than those who reforest after receiving income from harvesting. The stumpage price of sawtimber and the cost of tree planting were also found to be influential in the level of tree planting in the South. Landowners react to changes in the market place when planning their forests.

Future work could investigate the influence of the ACP, CRP, Soil Bank and income only on acres of trees planted on marginal farmland, as well as the influence of the FIP, SIP, State programs, and income only on acres of trees planted on cutover forestland. While this study reveals the effects of each cost share program on tree planting in the Southern region, a study that goes further by separating the amount of reforested acres from the amount of afforested acres could refine the information found here. Additionally, forms of tax incentives could be included in a random effects study to evaluate their importance on tree planting relative to cost-sharing programs. Though federal tax incentives for forestry are universal, Southern States individually have different State tax policies and incentives for tree planting. This study does not investigate program administration costs and their effect on tree planting. An important question is how much money appropriated for each program budget is passed onto landowners in cost-sharing and how much is lost in administration costs? This would be one way to evaluate the efficiency of each program. Future research, related to significant results of the CRP, could look at the decreasing number of acres planted in trees for every extra dollar spent in a given year since CRP applications are ranked in bid order, the smallest bid per acre accepted first. Over time we may also see that farmland afforestation programs are less effective than when they first started since these programs may reduce the acres of marginal farmland by foresting the most marginal lands first.

Chapter VII. Literature cited

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Appendix A: Forestry cost-sharing programs

Table of forestry cost share programs available to Southern NIPF landowners

Program	Coverage	Inception	Cost share rate (%)	Maximum payment ($/yr)	Ownership limit (ac.)	Project area limit (ac.)	Project duration (yrs)
ACDP	Alabama	1985	60	3,500	Min 20	Min 1	5 - 10
ACP	U.S.A.	1936	75				
CRP	U.S.A.	1985	50				10-15
FDP	North Carolina	1977	40-60			Max 100	
FRA	South Carolina	1982	50		Max 100	Max 100	10
FRDP	Mississippi	1974	50-75	8,000			10
FIP	U.S.A.	1974	50-65	10,000	1,000	Min 10	
PTP	Florida	1981	50	10,000	5 – 10,000		2
RF	Texas	1981	50			Min 10	10
RT	Virginia	1971	40	75/acre		1 - 500	10
Soil Bank	U.S.A.	1956					10
SIP	U.S.A.	1990	75	10,000	1,000	No min	

Notes: adapted from Mehmood and Zhang (1999), for program names see List of Acronyms (page viii).

Appendix B: Reforestation models

Table of the influence of selected independent variables in landowner choice models

Independent variable	Royer (1985)	Romm et al. (1987)	Royer (1987a)	Royer (1987b)	Royer & Moulton (1987)	Royer & Vasievich (1987)	Hodges (1989)	Hyberg & Holthausen (1989)	Hardie & Parks (1991)	Esseks et al. (1992)	Bell et al. (1994)	Hardie & Parks (1996)	Conway (1998)	Crabtree, et al. (1998)
	-- Dependent Variable --													
	Reforestation probability	Investment probability	Reforestation probability	Reforestation probability	Reforestation probability	Reforestation probability	Total Forest Investment	Reforestation probability	Reforestation probability	Cost share participation probability	Cost share participation probability	Reforestation probability	Reforestation probability	Cost share participation probability
Number of variables	14	14	9	9	8	8	6	9	10	6	19	11	9	10
Income	+/no	+/yes**	+/yes***	+/yes**	+/yes	+/yes		+/yes*	+/yes***	-/yes**	+/yes***	+/yes**	+/no	+/yes***
Size of holding	+/yes*	+/no	+/no	+/no			+/yes***	+/no	+/yes***	+/no	+/no	+/yes*	+/no	+/yes***
Stumpage	+/yes***		+/yes*		+/yes	+/yes		-/yes***	-/yes***			+/yes**	+/no	
Planting cost	-/yes*		-/yes***		-/yes	-/yes		-/yes***	-/yes**		-/yes***	-/yes**		
Interest rate														
Technical assistance	+/yes*		+/yes***	+/yes**	+/yes	+/yes	+/yes***	+/yes*		+/yes**				
Cost-sharing	+/yes*		+/yes***	+/yes**	+/yes	+/yes	+/yes*	+/yes***	+/yes*			+/yes**		
Tax incentive				+/no	+/yes	+/yes								
Harvest / output										+/yes**				
R^2	0.89		0.91	0.53			0.91		0.30			0.37		0.50

Note: adapted from the format found in Royer (1988).The expect sign of the variable is denoted by either a '+'or '-' symbol, then statistical significance denoted as 'yes', *significant at 0.2 level,**significant at 0.05 level, ***significant at 0.01 level

Table of the influence of selected independent variables in aggregate reforestation models

Independent variable	DeSteiguer (1982)	Cohen (1983)	Alig (1985)	Brooks (1985)	Skinner et al. (1989)	Lee & Kaiser (1992)	Rudel & Fu (1996)	Kline et al. (2002)
	-- Dependent variable --							
	Non-cost shared investment	Total acres planted	Percent forest use	Reforestation probability	Total acres planted	Total acres planted	Reforestation rate	Total acres planted
Number of variables	4	14	11	3	14	8	10	9
Income	+/yes	+/yes*	+/yes**		+/no			
Size of holding					+/no			
Stumpage	+/no	+/yes***	+/yes**	+/no		+/yes***		+/yes**
Planting cost		-/no		-/yes		-/yes***		-/yes***
Interest rate	-/yes	-/no			+/no	-/yes***		-/no
Technical assistance					+/no			
Cost-sharing	-/no	+/yes***	+/yes**	+/yes	+/yes*	+/yes***		+/yes***
Harvest / output	+/yes				+/no			+/yes***
R^2	0.98	0.78	0.88	0.95	0.53	0.98	0.55	0.92

Notes: adapted from the format found in Royer (1988). The expect sign of the variable is denoted by either a '+'or '-' symbol, then statistical significance denoted as 'yes', * significant at 0.2 level,**significant at 0.05 level, ***significant at 0.01 level

Appendix C: Time series data

Table of time series data

Year	Plant[1]	FIP[2]	SIP[3]	FSP[4]	FRM[5]	CRP[6]	ACP[7]	SB[8]	State[9]	Income[10]	Tbill[11]	Corn[12]	Saw[13]	Pulp[14]	CPI[15]	Cost[16]	Plalag[1]
1956	300,619	0	0	0	252,889	0	1,086,205	0	0	1,535	3.18	1.30	32.99	3.83	27.2	6.77	228,267
1957	452,691	0	0	0	353,897	0	1,712,286	2,096,442	0	1,584	3.65	1.16	30.95	4.23	28.1	7.19	300,619
1958	701,681	0	0	0	549,707	0	2,549,974	3,238,577	0	1,635	3.32	1.07	30.73	4.24	28.9	7.60	452,691
1959	1,175,097	0	0	0	550,460	0	3,122,035	3,868,728	0	1,716	4.33	1.07	31.79	4.26	29.1	8.02	701,681
1960	1,014,531	0	0	0	529,955	0	3,040,668	4,116,978	0	1,741	4.12	1.02	30.15	4.38	29.6	8.44	1,175,097
1961	661,304	0	0	0	530,852	0	2,648,751	936,616	0	1,801	3.88	1.01	27.86	4.26	29.9	8.82	1,014,531
1962	405,615	0	0	0	819,177	0	2,219,333	16,546	0	1,882	3.95	1.02	28.38	4.26	30.2	9.24	661,304
1963	335,539	0	0	0	820,500	0	1,641,620	525	0	1,971	4.00	1.12	27.05	4.31	30.6	10.13	405,615
1964	300,724	0	0	0	824,310	0	1,552,687	0	0	2,096	4.19	1.13	27.01	4.30	31.0	11.02	335,539
1965	274,785	0	0	0	952,179	0	1,302,857	0	0	2,248	4.28	1.18	28.43	4.38	31.5	11.91	300,724
1966	266,604	0	0	0	1,085,300	0	1,300,240	0	0	2,440	4.92	1.25	34.25	4.53	32.4	12.80	274,785
1967	308,710	0	0	0	1,226,900	0	1,375,021	0	0	2,626	5.07	1.17	36.79	4.58	33.4	13.68	266,604
1968	264,423	0	0	0	1,228,300	0	1,057,512	0	0	2,882	5.65	1.04	40.54	4.64	34.8	15.96	308,710
1969	209,138	0	0	0	1,217,290	0	910,512	0	0	3,156	6.67	1.13	50.14	4.65	36.7	18.23	264,423
1970	274,499	0	0	0	1,461,000	0	1,003,493	0	0	3,412	7.35	1.23	46.39	4.70	38.8	20.50	209,138
1971	201,405	0	0	0	1,927,500	0	1,474,047	0	269,946	3,657	6.16	1.27	55.95	4.74	40.5	22.78	274,499
1972	277,287	0	0	0	1,880,500	0	2,619,967	0	311,466	4,010	6.21	1.17	66.31	4.76	41.8	25.05	201,405
1973	271,002	0	0	0	1,880,500	0	906,992	0	335,281	4,489	6.84	1.89	84.18	5.20	44.4	27.32	277,287
1974	227,943	5,490,790	0	0	1,910,800	0	772,735	0	369,192	4,928	7.56	2.92	90.90	6.05	49.3	29.60	271,002
1975	284,375	.	0	0	1,996,600	0	722,768	0	909,397	5,310	7.99	2.70	81.55	6.41	53.8	33.03	227,943
1976	265,598	.	0	0	2,236,900	0	121,658	0	910,600	5,868	7.61	2.49	101.08	6.68	56.9	36.47	284,375
1977	310,907	7,417,675	0	0	1,794,000	0	496,425	0	1,136,391	6,441	7.42	2.03	119.74	7.08	60.6	38.53	265,598
1978	304,707	9,123,951	0	0	1,840,000	0	498,402	0	1,934,178	7,253	8.41	2.10	149.74	7.68	65.2	40.59	310,907
1979	325,548	10,946,844	0	0	1,840,000	0	618,590	0	2,526,328	8,116	9.44	2.36	211.05	9.31	72.6	42.65	304,707
1980	426,970	10,432,951	0	0	2,315,000	0	1,264,761	0	3,271,491	9,028	11.46	2.70	189.18	10.30	82.4	44.97	325,548
1981	466,529	13,709,576	0	0	3,404,000	0	1,418,462	0	3,162,280	10,144	13.91	2.92	184.97	12.64	90.9	47.29	426,970
1982	474,719	9,316,015	0	0	4,042,066	0	1,510,481	0	3,915,864	10,720	13.00	2.37	144.55	14.32	96.5	49.62	466,529
1983	510,081	7,754,143	0	0	2,836,000	0	1,935,295	0	4,256,272	11,287	11.10	2.99	160.73	14.83	99.6	48.70	474,719
1984	620,667	6,062,287	0	0	1,844,900	0	1,717,324	0	3,892,547	12,425	12.44	3.05	158.83	17.64	103.9	47.79	510,081
1985	743,757	7,623,991	0	0	1,818,900	0	2,719,733	0	5,519,016	13,225	10.62	2.49	118.15	15.20	107.6	48.22	620,667
1986	790,656	8,724,390	0	0	1,770,700	5,639,069	3,379,360	0	8,426,370	13,702	7.68	1.96	112.30	12.07	109.6	48.65	743,757
1987	1,196,146	5,545,305	0	0	1,864,000	22,345,074	4,014,940	0	8,113,094	14,397	8.39	1.56	147.33	13.83	113.6	48.80	790,656
1988	1,462,068	8,031,471	0	0	1,858,000	15,426,463	5,641,986	0	8,651,718	15,395	8.85	2.27	160.95	15.95	118.3	48.94	1,196,146
1989	1,202,436	8,870,716	0	0	1,775,000	12,722,082	6,115,460	0	9,337,051	16,477	8.49	2.43	169.11	18.33	124.0	48.85	1,462,068
1990	987,016	8,411,198	0	0	4,455,000	6,292,723	5,620,945	0	8,722,147	17,436	8.55	2.40	182.61	17.88	130.7	48.76	1,202,436
1991	756,314	9,525,430	0	4,921,692	199,600	2,848,621	6,529,760	0	8,649,452	17,958	7.86	2.33	194.27	20.80	136.2	50.15	987,016
1992	816,104	9,074,751	178,001	5,190,700	2,353,000	3,146,712	5,607,274	0	7,985,965	18,827	7.01	2.29	222.55	23.50	140.3	51.54	756,314
1993	802,348	8,932,000	2,033,319	5,163,000	1,835,000	4,109,707	5,694,778	0	8,606,472	19,543	5.87	2.22	273.34	25.07	144.5	52.83	816,104
1994	865,004	9,516,000	3,744,083	5,754,000	2,208,000	0	6,132,675	0	10,447,748	20,336	7.09	2.41	330.53	23.51	148.2	54.13	802,348
1995	811,890	4,775,000	3,618,415	5,403,419	2,267,000	0	4,964,425	0	10,563,505	21,208	6.57	2.56	382.72	24.07	152.4	55.86	865,004
1996	900,003	5,033,000	3,141,218	5,322,000	1,978,000	2,199,239	3,583,557	0	9,976,976	22,121	6.44	3.55	344.57	23.62	156.9	57.58	811,890
1997	877,836	4,859,900	1,680,767	4,965,950	2,043,000	616,182	2,754,761	0	10,436,535	23,239	6.35	2.60	412.39	26.61	160.5	60.04	900,003
1998	1,108,598	4,705,900	725,297	4,939,000	2,135,000	6,246,563	387,902	0	11,700,057	24,487	5.26	2.20	396.01	29.24	163.0	62.50	877,836
1999	1,116,066	3,823,470	1,248,769	5,678,000	2,874,000	4,656,531	214,889	0	11,815,829	25,361	5.65	1.89	368.62	26.28	166.6	64.54	1,108,598

Notes:

. Denotes a missing data

1 Non-industrial Private Tree-planting acres including seeding, 1956-1985 USDA Forest Service (1986), 1986-1999 Tree Planters Notes, USDA Forest Service, fiscal year data, acres

2 Forestry Incentives Program, 1974 RECP Fiscal year report, 1975-1995 FIP fiscal year reports, 1995-2000, Robert Molleur, FIP National Program Manager, NRCS, fiscal year data, dollars

3 Stewardship Incentives Program, 1992-1999, SIP fiscal year reports

4 Forest Stewardship Program, 1991-2000, USDA Forest Service, Budget Explanatory Notes/Presidents Report, State and Private Forestry Section, fiscal year reports, dollars

5 Forest Resource Management / Nursery Tree Improvement, 1956-2000, Budget Explanatory Notes/Presidents Report, State and Private Forestry Section, Internal FS Letters, fiscal year data, dollars

6 Conservation Reserve Program, 1986-2000, Cathy Kasack, USDA Farm Service, fiscal year data, dollars

7 Agricultural Conservation Program, 1950-1999, ACP fiscal year reports, dollars

8 Soil Bank Program, 1956-1963, Conservation Reserve Program of the Soil Bank calendar year reports, dollars

9 State NIPF cost share programs, State forestry agencies, fiscal or calendar year data, dollars

10 Nominal Personal Income for the South, Bureau of Economic Analysis, calendar year data, dollars per capita

11 Treasury 10 year bond rate, Economic Report of the President 2001, B-73 (1953-2000), calendar year data, percent

12 Nominal corn for grain price ($/bushel), NASS, http://www.nass.usda.gov:81/ipedb/ , calendar year data, dollars per bushel

13 Nominal pine saw log stumpage price, Louisiana Department of Forestry, calendar year data, dollars per thousand board feet

14 Nominal pine pulpwood stumpage price, Louisiana Department of Forestry, calendar year data, dollars per cord

15 Consumer price index, all items, Economic Report of the President 2001, B-60 (1958-2000) B-64 (1950-1957), calendar year data

16 Nominal weighted series of Southern planting costs - Dubois et al.(2001), series updated from Kline et al.(2002), calendar year data (2001), dollars per acre

Appendix D: Cross-sectional time series data

Table of cross-sectional time series data

Year	Plant[1]	State[*]	FIP[2]	SIP[3]	CRP[4]	ACP[5]	Sta[6]	Inc[7]	Saw[8]	Pul[9]	CPI[10]	Plalag[1]
1979	46,044	1	2,075,923	0	0	82,138	0	7,199	166	15.67	72.60	31,198
1980	59,800	1	2,007,399	0	0	284,201	0	7,892	126	16.73	82.40	46,044
1981	59,204	1	1,970,138	0	0	233,860	0	8,712	157	17.29	90.90	59,800
1982	65,750	1	1,076,650	0	0	223,365	0	9,185	152	17.21	96.50	59,204
1983	75,000	1	1,087,659	0	0	384,691	0	9,783	178	17.00	99.60	65,750
1984	59,200	1	660,143	0	0	257,457	0	10,800	166	17.96	103.90	75,000
1985	65,200	1	955,232	0	0	521,817	0	11,583	143	18.65	107.60	59,200
1986	101,918	1	1,070,212	0	1,178,680	497,789	666,667	12,202	142	18.75	109.60	65,200
1987	179,400	1	688,438	0	3,851,899	757,466	844,582	12,912	130	15.76	113.60	101,918
1988	213,200	1	725,646	0	2,619,000	1,036,052	889,392	13,842	149	15.35	118.30	179,400
1989	142,720	1	874,705	0	1,893,452	1,258,234	875,646	14,899	155	16.24	124.00	213,200
1990	97,947	1	839,421	0	562,714	1,274,397	846,425	15,832	153	20.92	130.70	142,720
1991	111,194	1	999,175	0	615,139	1,411,068	910,289	16,547	156	21.73	136.20	97,947
1992	113,692	1	930,623	176	457,474	1,399,950	852,684	17,509	188	22.92	140.30	111,194
1993	94,972	1	921,000	279,111	608,290	1,583,342	732,675	18,099	239	27.56	144.50	113,692
1994	88,406	1	936,000	388,976	0	1,531,687	707,491	18,972	294	30.17	148.20	94,972
1995	115,066	1	519,000	410,976	0	1,580,436	708,796	19,752	293	30.57	152.40	88,406
1996	120,721	1	502,000	457,934	249,294	873,963	592,301	20,342	259	26.97	156.90	115,066
1997	140,435	1	626,000	285,781	115,258	390,764	708,967	21,094	368	32.40	160.50	120,721
1998	162,330	1	531,800	1,532	1,059,608	3,936	708,804	22,035	376	32.87	163.00	140,435
1999	116,653	1	412,193	0	1,315,729	0	709,079	22,777	355	26.47	166.60	162,330
1979	10,985	2	787,070	0	0	9,575	0	7,088	174	9.15	72.60	9,022
1980	27,409	2	122,762	0	0	80,395	0	7,586	157	9.84	82.40	10,985
1981	19,208	2	1,173,454	0	0	37,877	0	8,564	163	11.27	90.90	27,409
1982	21,627	2	850,906	0	0	48,723	0	8,952	145	13.79	96.50	19,208
1983	19,624	2	616,179	0	0	55,991	0	9,476	156	15.23	99.60	21,627
1984	15,773	2	561,814	0	0	20,628	0	10,560	151	16.88	103.90	19,624
1985	22,926	2	636,822	0	0	33,898	0	11,264	121	13.13	107.60	15,773
1986	23,975	2	706,957	0	453,971	60,989	0	11,734	120	11.25	109.60	22,926
1987	45,225	2	458,517	0	1,410,503	65,802	0	12,184	102	10.65	113.60	23,975
1988	63,952	2	695,744	0	1,324,862	72,403	0	13,016	115	11.70	118.30	45,225
1989	61,856	2	692,647	0	1,400,505	46,654	0	13,813	115	12.30	124.00	63,952
1990	62,226	2	744,646	0	671,753	53,803	0	14,509	128	13.19	130.70	61,856
1991	52,854	2	659,227	0	368,820	39,956	0	15,155	132	16.38	136.20	62,226
1992	54,613	2	784,924	0	419,431	34,617	0	16,261	175	17.53	140.30	52,854
1993	50,290	2	712,000	71,779	572,264	49,113	0	16,812	225	20.41	144.50	54,613
1994	47,138	2	752,000	201,822	0	62,029	0	17,526	300	22.79	148.20	50,290
1995	43,766	2	410,000	226,514	0	57,828	0	18,297	292	17.65	152.40	47,138
1996	53,333	2	275,000	214,040	107,471	26,444	0	19,130	230	16.22	156.90	43,766
1997	4,500	2	393,000	68,452	28,295	52,696	0	19,807	267	16.87	160.50	53,333
1998	47,300	2	402,500	75,450	255,263	3,192	0	20,675	300	16.22	163.00	4,500
1999	31,001	2	180,746	86,731	96,094	6,486	0	21,474	273	16.07	166.60	47,300
1979	18,629	3	771,812	0	0	123,097	0	8,879	149	19.77	72.60	18,455
1980	32,062	3	873,575	0	0	141,397	0	10,049	114	22.84	82.40	18,629
1981	55,644	3	1,028,030	0	0	240,995	0	11,195	144	25.58	90.90	32,062

Year	Plant[1]	State[*]	FIP[2]	SIP[3]	CRP[4]	ACP[5]	Sta[6]	Inc[7]	Saw[8]	Pul[9]	CPI[10]	Plalag[1]
1982	67,349	3	893,492	0	0	237,918	0	11,789	139	26.67	96.50	55,644
1983	56,987	3	660,217	0	0	312,590	0	12,637	170	25.92	99.60	67,349
1984	93,550	3	691,329	0	0	273,673	0	13,764	166	29.06	103.90	56,987
1985	88,472	3	997,884	0	0	468,345	0	14,705	147	24.88	107.60	93,550
1986	84,815	3	1,008,747	0	218,017	660,927	0	15,423	132	21.67	109.60	88,472
1987	103,526	3	826,273	0	770,065	794,824	0	16,415	139	18.36	113.60	84,815
1988	109,487	3	908,657	0	848,208	805,058	0	17,593	151	18.46	118.30	103,526
1989	95,017	3	1,007,377	0	585,707	749,048	0	19,045	136	31.81	124.00	109,487
1990	74,354	3	1,081,584	0	295,703	812,007	0	19,855	150	33.03	130.70	95,017
1991	55,354	3	1,379,260	0	63,836	964,711	0	20,151	151	34.25	136.20	74,354
1992	72,842	3	1,124,377	27,648	125,407	893,732	0	20,500	176	35.85	140.30	55,354
1993	66,167	3	1,105,000	214,827	182,740	1,000,510	0	21,350	194	44.56	144.50	72,842
1994	54,573	3	1,090,000	322,950	0	949,487	0	21,959	236	35.15	148.20	66,167
1995	48,679	3	503,000	273,588	0	939,858	0	23,001	283	33.05	152.40	54,573
1996	61,543	3	530,000	342,197	60,344	840,840	0	24,001	240	37.77	156.90	48,679
1997	70,069	3	500,000	157,300	33,266	753,318	0	25,023	300	39.92	160.50	61,543
1998	67,422	3	516,300	56,736	143,126	94,209	0	26,088	311	41.84	163.00	70,069
1999	78,561	3	443,954	203,095	53,520	49,462	0	26,763	302	32.81	166.60	67,422
1979	35,725	4	1,213,230	0	0	94,598	0	7,722	148	18.29	72.60	35,317
1980	40,333	4	1,708,619	0	0	104,452	0	8,474	124	20.32	82.40	35,725
1981	62,051	4	1,814,573	0	0	276,631	0	9,435	149	22.69	90.90	40,333
1982	87,838	4	1,520,753	0	0	316,290	0	10,054	152	24.46	96.50	62,051
1983	93,076	4	1,151,426	0	0	455,397	0	10,849	174	24.63	99.60	87,838
1984	157,947	4	934,294	0	0	423,150	0	12,185	169	23.33	103.90	93,076
1985	232,287	4	1,144,959	0	0	767,114	0	13,143	150	20.90	107.60	157,947
1986	220,275	4	1,287,696	0	1,380,183	1,002,035	0	13,990	150	18.67	109.60	232,287
1987	343,691	4	752,368	0	6,369,056	1,144,552	0	14,820	152	18.22	113.60	220,275
1988	416,800	4	1,419,181	0	4,714,627	2,010,801	0	15,876	157	18.30	118.30	343,691
1989	357,592	4	1,335,638	0	4,442,923	2,250,829	0	16,803	156	23.31	124.00	416,800
1990	220,719	4	1,080,830	0	2,122,141	1,701,233	0	17,738	179	27.54	130.70	357,592
1991	190,729	4	1,373,068	0	473,710	2,004,050	0	18,143	162	24.46	136.20	220,719
1992	160,657	4	1,419,082	41,683	494,076	1,558,861	0	19,099	210	32.02	140.30	190,729
1993	171,189	4	1,300,000	455,279	625,271	1,360,902	0	19,795	242	33.74	144.50	160,657
1994	192,903	4	1,388,000	816,758	0	1,630,371	0	20,779	277	28.97	148.20	171,189
1995	154,872	4	605,000	574,461	0	932,082	0	21,752	328	35.91	152.40	192,903
1996	194,759	4	600,000	659,877	246,266	1,104,879	0	23,014	297	32.53	156.90	154,872
1997	221,276	4	600,000	261,029	79,638	721,906	0	23,919	338	36.59	160.50	194,759
1998	259,660	4	607,700	180,423	428,781	174,621	0	25,433	363	36.68	163.00	221,276
1999	267,167	4	592,007	374,197	464,338	131,374	0	26,540	349	27.12	166.60	259,660
1979	17,708	5	708,418	0	0	1,951	0	7,813	175	9.15	72.60	17,440
1980	19,245	5	875,556	0	0	5,079	0	8,833	170	9.50	82.40	17,708
1981	21,034	5	867,279	0	0	2,014	0	10,037	183	10.92	90.90	19,245
1982	15,000	5	563,241	0	0	28,570	0	10,558	153	15.35	96.50	21,034
1983	14,628	5	577,547	0	0	46,805	0	10,865	158	16.40	99.60	15,000
1984	18,520	5	496,604	0	0	26,705	0	11,628	157	17.31	103.90	14,628
1985	17,739	5	534,134	0	0	39,140	0	12,121	122	14.89	107.60	18,520
1986	16,005	5	642,953	0	126,956	29,544	0	12,028	100	12.04	109.60	17,739
1987	25,463	5	492,800	0	612,672	14,449	0	12,266	109	11.67	113.60	16,005
1988	31,851	5	687,371	0	709,052	44,269	0	13,113	129	15.16	118.30	25,463

Year	Plant[1]	State[*]	FIP[2]	SIP[3]	CRP[4]	ACP[5]	Sta[6]	Inc[7]	Saw[8]	Pul[9]	CPI[10]	Plalag[1]
1989	44,070	5	687,409	0	365,736	37,255	0	13,997	133	15.65	124.00	31,851
1990	49,232	5	639,755	0	130,604	27,307	0	15,223	146	15.00	130.70	44,070
1991	12,326	5	683,921	0	135,784	160,298	0	16,064	148	20.06	136.20	49,232
1992	38,000	5	605,093	10,060	84,402	97,696	0	16,974	185	22.58	140.30	12,326
1993	29,800	5	643,000	67,097	152,707	77,496	0	17,678	209	22.60	144.50	38,000
1994	31,500	5	646,000	157,481	0	204,969	0	18,724	258	22.56	148.20	29,800
1995	29,809	5	340,000	192,917	0	230,982	0	19,469	303	24.86	152.40	31,500
1996	28,195	5	515,000	160,314	240,092	67,412	0	20,114	254	21.48	156.90	29,809
1997	48,123	5	345,000	76,858	60,595	181,341	0	21,003	338	29.64	160.50	28,195
1998	27,820	5	353,000	53,925	1,495,780	48,359	0	22,067	325	28.13	163.00	48,123
1999	66,078	5	265,180	40,791	999,235	6,185	0	22,470	296	27.97	166.60	27,820
1979	42,728	6	977,251	0	0	40,055	1,171,861	6,549	170	9.98	72.60	45,682
1980	59,864	6	1,074,053	0	0	70,669	1270523	7,076	149	11.05	82.40	42,728
1981	49,251	6	1,187,288	0	0	104,495	908,733	7,901	172	11.71	90.90	59,864
1982	46,559	6	790,278	0	0	191,600	1,690,268	8,301	134	12.35	96.50	49,251
1983	69,882	6	599,900	0	0	138,499	1,473,292	8,615	152	12.81	99.60	46,559
1984	78,474	6	605,346	0	0	72,821	1,185,152	9,463	144	14.13	103.90	69,882
1985	92,226	6	832,623	0	0	321,025	2420957	9,922	126	13.33	107.60	78,474
1986	113,283	6	871,826	0	1,437,806	346,596	2,693,435	10,293	112	10.86	109.60	92,226
1987	154,842	6	372,555	0	5,438,514	274,009	2,117,638	10,913	113	10.15	113.60	113,283
1988	257,563	6	276,728	0	2,539,263	223,572	2,580,485	11,695	131	11.03	118.30	154,842
1989	134,596	6	1,071,518	0	2,044,430	447,048	3,555,939	12,540	151	11.38	124.00	257,563
1990	170,869	6	1,130,790	0	1,616,325	522,119	3,070,699	13,164	149	12.94	130.70	134,596
1991	129,594	6	999,924	0	901,191	656,802	3,268,913	13,738	151	14.50	136.20	170,869
1992	139,510	6	668,163	0	1,298,253	490,820	3,257,687	14,595	185	18.06	140.30	129,594
1993	158,286	6	980,000	412,698	1,589,197	620,179	2,925,961	15,340	233	23.92	144.50	139,510
1994	148,862	6	1,029,000	611,491	0	672,990	3,688,879	16,420	313	25.75	148.20	158,286
1995	131,123	6	477,000	675,030	0	519,988	3,336,576	17,057	327	28.43	152.40	148,862
1996	143,539	6	477,000	277,279	1,085,774	141,352	3,183,015	17,861	271	26.70	156.90	131,123
1997	138,138	6	488,600	234,104	273,295	295,348	3,257,966	18,664	346	32.85	160.50	143,539
1998	243,188	6	505,200	114,231	2,244,937	8,914	4,504,589	19,697	358	35.56	163.00	138,138
1999	189,985	6	397,607	52,441	1,305,911	1,388	4,069,078	20,324	362	24.51	166.60	243,188
1979	33,259	7	1,278,645	0	0	54,383	1,094,217	7,461	147	7.65	72.60	27,003
1980	44,523	7	1,322,849	0	0	50,497	1,101,449	8,247	121	7.75	82.40	33,259
1981	44,799	7	1,254,292	0	0	83,305	1,226,786	9,184	152	8.27	90.90	44,523
1982	39,031	7	810,782	0	0	104,589	1,106,796	9,690	134	8.73	96.50	44,799
1983	43,778	7	657,379	0	0	130,180	1,877,395	10,480	155	9.23	99.60	39,031
1984	55,184	7	358,188	0	0	78,530	1,645,968	11,788	155	10.56	103.90	43,778
1985	58,400	7	534,761	0	0	101,542	1,702,759	12,649	132	9.92	107.60	55,184
1986	48,241	7	603,296	0	165,519	108,532	3,006,304	13,444	141	8.84	109.60	58,400
1987	66,175	7	374,951	0	785,028	96,025	3,239,902	14,325	117	10.74	113.60	48,241
1988	93,525	7	631,101	0	736,081	120,228	3,340,405	15,461	121	11.72	118.30	66,175
1989	86,924	7	633,780	0	442,472	101,374	3,177,152	16,539	132	11.39	124.00	93,525
1990	72,924	7	526,507	0	176,098	101,786	3,280,252	17,367	140	12.79	130.70	86,924
1991	69,961	7	698,314	0	52,821	86,778	2,948,393	17,752	133	15.46	136.20	72,924
1992	72,580	7	717,012	22	69,960	59,910	2,508,454	18,835	144	15.71	140.30	69,961
1993	70,738	7	600,000	1,000	107,905	37,016	3,497,268	19,681	147	17.62	144.50	72,580
1994	81,076	7	630,000	24,526	0	35,645	4,346,789	20,487	178	16.29	148.20	70,738
1995	81,565	7	331,000	74,288	0	35,612	4,571,500	21,438	171	16.04	152.40	81,076

Year	Plant[1]	State[*]	FIP[2]	SIP[3]	CRP[4]	ACP[5]	Sta[6]	Inc[7]	Saw[8]	Pul[9]	CPI[10]	Plalag[1]
1996	92,486	7	360,000	45,528	49,366	37,272	4,007,930	22,374	180	13.74	156.90	81,565
1997	75,976	7	383,500	59,757	1,310	28,061	3,608,822	23,546	207	14.42	160.50	92,486
1998	77,485	7	340,300	55,405	71,111	3,360	3,359,055	24,715	237	17.02	163.00	75,976
1999	90,480	7	180,883	90,190	31,607	0	4,161,214	25,551	261	16.52	166.60	77,485
1979	30,820	8	1,161,269	0	0	98,265	0	7,044	156	13.60	72.60	26,797
1980	32,636	8	1,068,822	0	0	281,044	0	7,794	128	13.82	82.40	30,820
1981	50,590	8	1,770,451	0	0	242,495	0	8,651	150	12.79	90.90	32,636
1982	34,103	8	1,003,488	0	0	173,427	0	9,071	147	15.29	96.50	50,590
1983	40,493	8	833,134	0	0	200,121	0	9,775	166	16.94	99.60	34,103
1984	38,725	8	763,532	0	0	181,979	0	10,910	165	18.08	103.90	40,493
1985	64,596	8	858,868	0	0	319,656	0	11,666	149	16.42	107.60	38,725
1986	79,566	8	956,205	0	338,548	538,470	500,000	12,258	148	14.92	109.60	64,596
1987	139,335	8	750,005	0	2,032,987	731,546	500,000	13,056	132	14.72	113.60	79,566
1988	156,873	8	928,852	0	1,054,560	971,849	500,000	14,045	157	14.74	118.30	139,335
1989	134,528	8	815,347	0	909,761	961,739	500,000	14,834	139	15.67	124.00	156,873
1990	124,298	8	808,984	0	429,697	817,296	500,000	16,050	159	15.39	130.70	134,528
1991	48,080	8	1,051,113	0	45,297	862,959	500,000	16,451	155	18.13	136.20	124,298
1992	50,766	8	1,135,869	0	78,619	760,289	500,000	17,160	193	21.53	140.30	48,080
1993	49,166	8	1,040,000	59,381	147,631	702,675	500,000	17,715	198	24.38	144.50	50,766
1994	104,849	8	1,044,000	211,411	0	795,348	500,000	18,495	256	20.96	148.20	49,166
1995	86,938	8	486,000	152,088	0	462,386	500,000	19,185	277	23.33	152.40	104,849
1996	79,698	8	612,000	217,609	60,432	344,181	1,000,000	20,039	279	23.53	156.90	86,938
1997	56,493	8	491,100	117,245	18,474	223,042	1,000,000	21,006	317	26.98	160.50	79,698
1998	63,891	8	494,700	61,003	391,324	36,262	1,000,000	22,142	322	27.08	163.00	56,493
1999	107,169	8	562,700	206,163	275,396	18,201	1,000,000	23,092	317	22.52	166.60	63,891
1979	16,185	9	673,212	0	0	10,650	0	8,929	182	9.17	72.60	14,715
1980	20,193	9	949,021	0	0	66,217	0	9,957	180	9.25	82.40	16,185
1981	29,060	9	1,116,874	0	0	51,764	104,992	11,391	196	10.46	90.90	20,193
1982	25,937	9	593,597	0	0	27,015	186,529	11,961	165	14.31	96.50	29,060
1983	28,440	9	621,918	0	0	59,447	312,004	12,303	164	14.71	99.60	25,937
1984	27,725	9	271,201	0	0	22,623	256,026	13,396	156	17.04	103.90	28,440
1985	23,605	9	318,086	0	0	13,755	417,182	14,196	114	15.10	107.60	27,725
1986	20,815	9	477,165	0	51,803	5,815	446,407	14,165	105	10.50	109.60	23,605
1987	26,156	9	323,496	0	105,969	3,095	345,930	14,486	106	12.77	113.60	20,815
1988	22,426	9	567,859	0	116,678	12,746	418,442	15,324	136	13.41	118.30	26,156
1989	25,076	9	655,653	0	126,398	16,426	397,954	16,323	129	14.63	124.00	22,426
1990	25,301	9	532,643	0	115,992	9,161	319,701	17,458	127	14.38	130.70	25,076
1991	2,191	9	473,264	0	55,759	48,139	386,963	18,061	139	17.63	136.20	25,301
1992	29,662	9	557,573	0	33,245	83,527	270,639	18,979	170	21.01	140.30	2,191
1993	33,018	9	521,000	117,582	8,331	62,196	386,090	19,618	204	22.03	144.50	29,662
1994	30,714	9	871,000	271,093	0	47,369	494,057	20,336	276	19.50	148.20	33,018
1995	35,812	9	612,000	260,243	0	26,853	457,112	21,221	315	21.04	152.40	30,714
1996	43,161	9	612,000	228,345	5,030	27,187	359,927	22,180	266	21.33	156.90	35,812
1997	43,161	9	410,200	89,604	0	44,561	416,793	23,793	351	25.39	160.50	43,161
1998	67,260	9	416,400	7,831	38,604	0	515,656	25,307	313	30.64	163.00	43,161
1999	55,006	9	348,014	27,651	10,266	0	415,879	26,274	281	28.78	166.60	67,260
1979	51,638	10	990,241	0	0	67,080	260,250	8,995	88	7.09	72.60	60,149
1980	62,948	10	1,099,160	0	0	141,101	899,519	10,176	71	8.60	82.40	51,638

Year	Plant[1]	State[*]	FIP[2]	SIP[3]	CRP[4]	ACP[5]	Sta[6]	Inc[7]	Saw[8]	Pul[9]	CPI[10]	Plalag[1]
1981	56,863	10	1,100,212	0	0	103,734	921,769	11,291	77	8.94	90.90	62,948
1982	53,738	10	918,686	0	0	114,240	932,271	12,075	79	10.27	96.50	56,863
1983	48,517	10	632,033	0	0	105,889	593,581	12,936	101	10.40	99.60	53,738
1984	56,274	10	484,163	0	0	323,367	805,401	14,298	122	10.50	103.90	48,517
1985	57,958	10	579,631	0	0	94,060	978,118	15,286	100	10.40	107.60	56,274
1986	58,795	10	735,816	0	68,650	90,463	1,113,557	16,237	100	11.53	109.60	57,958
1987	82,164	10	340,180	0	436,939	68,089	1,065,041	17,332	108	10.86	113.60	58,795
1988	64,331	10	949,454	0	451,056	290,462	922,994	18,556	112	10.75	118.30	82,164
1989	88,566	10	813,413	0	274,260	192,497	830,360	19,780	106	11.75	124.00	64,331
1990	67,959	10	742,373	0	94,700	242,759	705,070	20,538	105	12.32	130.70	88,566
1991	63,732	10	967,518	0	23,747	224,600	634,895	21,037	106	10.88	136.20	67,959
1992	60,697	10	872,770	29,557	15,942	167,784	596,501	21,954	134	13.48	140.30	63,732
1993	57,427	10	862,000	0	33,900	150,362	564,478	22,744	157	13.61	144.50	60,697
1994	62,691	10	905,000	120,608	0	147,329	710,532	23,627	175	16.65	148.20	57,427
1995	65,386	10	386,000	161,165	0	121,932	989,521	24,291	189	12.94	152.40	62,691
1996	69,988	10	330,000	188,165	5,946	63,678	833,803	25,241	183	15.46	156.90	65,386
1997	68,001	10	496,900	114,061	395	25,530	1,443,987	26,425	199	19.10	160.50	69,988
1998	71,126	10	386,000	35,356	16,793	2,259	1,611,953	27,892	252	23.14	163.00	68,001
1999	95,321	10	325,072	28,142	18,133	0	1,460,579	29,286	210	21.61	166.60	71,126

Notes:
* State data codes

1 - Alabama, 2 - Arkansas, 3 – Florida, 4 – Georgia, 5 – Louisiana, 6 – Mississippi, 7 – South Carolina, 8 – North Carolina, 9 – Texas, 10 – Virginia.

Numeric super-script codes

1 Non-industrial private tree-planting acres including seeding, 1979-1985 USDA Forest Service (1986), 1986-1999 Tree Planters Notes, USDA Forest Service, fiscal year data, acres
2 Forestry Incentives Program, 1979-1995 FIP fiscal year reports, 1995-2000, Robert Molleur, FIP National Program Manager, NRCS, fiscal year data, dollars
3 Stewardship Incentives Program, 1992-1999, SIP fiscal year reports, fiscal year data, dollars
4 Conservation Reserve Program, 1986-2000, Cathy Kasack, USDA Farm Service, fiscal year data, dollars
5 Agricultural Conservation Program, 1979-1999, ACP fiscal year reports, dollars
6 State NIPF cost share programs, State forestry agencies, fiscal or calendar year data, dollars
7 Nominal Personal Income, Bureau of Economic Analysis, calendar year data, dollars per capita
8 Nominal pine saw log stumpage price, Louisiana Department of Forestry, calendar year data, dollars per thousand board feet
9 Nominal pine pulpwood stumpage price, Louisiana Department of Forestry, calendar year data, dollars per cord
10 Consumer price index, all items, Economic Report of the President 2001, B-60 (1979-2000), calendar year data

Vita

Christopher C. Goodwin was born in Auckland, New Zealand. He received his Bachelor of Forestry Science from the University of Canterbury in 1999, and his Master of Science from Virginia Tech in 2001.