Evaluating the Regional and Distributional Impacts of Forestry Cost-Share Payments

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Standard methods of welfare economics are used in a market simulating framework to evaluate policy measures designed to increase future timber supplies. Forest management cost-share programs are examined using this methodology. The differential regional impact of cost-share payments is considered, as is the distribution of these benefits between stumpage producers (owners of forest land) and stumpage consumers (producers of forest products). Previous estimates of the welfare gains that would result from a higher level of forest management cost-share payments in the southern United States are revised to account for the loss of public revenue resulting from lower future prices. A methodology for comparing alternative policy instruments is discussed, and a preliminary, qualitative comparison is made between the use of cost-share payments and alternative policy measures.

Introduction

Few forest policies in the United States stimulate debate more contentious than that joined over programs that share the cost of forest management carried out on land owned by individuals in the nonindustrial, private ownership category. The central questions of this debate are:

1) is there a need for public intervention to increase future timber supplies?
2) what type of intervention is appropriate?
3) what is the effect of intervention, once made?

This paper does not address the first question (identifying a failure of the market to accurately anticipate future prices), and touches only briefly on the second question (comparing alternative methods of intervention). This paper focuses, instead, on the problem of evaluating the effectiveness of one policy instrument in achieving the goal of affecting future timber supplies and prices. There are two parts to this evaluation. The first is a determination of whether or not the policy instrument actually achieves the stated objective; the second is an examination of the concomitant (or secondary) consequences of using this policy instrument.

The term "policy instrument" is used here to indicate that this analysis has a broader objective than program evaluation. "Instruments" refers to the means by which policies are to be carried out, but indicates a level of abstraction above specific programs. In order to conduct broad-based policy analysis, different programs are treated as manifestations of the same "instrument." This taxonomy requires that the programs in question have the same primary policy objective, and that they represent the same type of market intervention. Programs classified under one instrument do not necessarily use the same procedures or guidelines, however.

While it is not possible (or even desirable) to separate the evaluation of policy instruments from the assessment of the performance of specific programs, program evaluation focuses on a more narrow set of questions, and a shorter time horizon. Program evaluation does not (generally) consider the cumulative, long-term impact of program activities, but does address questions concerning the effectiveness of procedures. The broader-based analysis undertaken here is designed to address the question of the extent to which a given policy instrument is likely to achieve a long-term policy goal.

The public policy instrument examined in detail in this paper is the payment of some portion of the cost of forest management practices carried out on private land. These "cost-share" payments are made available only to non-corporate owners of forest land who are not also owners of timber processing facilities. This owner group is commonly referred to as "other private" owners, to distinguish them from "forest industry" owners and suppliers of stumpage.[1] The primary goal of forest management cost-share programs, whether funded at the federal or at the state level, is to mitigate an upward trend in forest product prices by increasing future timber supplies. In the enabling legislation for the 1973 federal Forestry Incentives Program (FIP), for example, this purpose is stated as assuring "plentiful supplies" at "reasonable prices" (PL-93-86, sec. 4). State-funded cost-share programs, begun in the 1970's by a number of states in the southern United States, have a similar purpose.

This paper begins with a discussion of the use of the techniques of applied welfare economics in analyzing timber supply policy questions. Next, forestry cost-share expenditures are examined using this methodology, supported by a large-scale spatial equilibrium simulation model. This is a revision and extension of an analysis reported in Brooks (1985). Finally, a methodology for comparing policy instruments with equivalent objectives is discussed. A preliminary comparison is made between public expenditures to increase timber supplies from private land (cost-share payments) and public expenditures that increase timber supplies from public lands.

[1] The terms "stumpage supply" and "timber supply" are used interchangeably here, because most forest land owners sell timber "standing on the stump" (i.e., as "stumpage").

Welfare economics and timber supply policy

In applied welfare economics there is now a long history of measuring changes in social welfare through changes in consumer and producer surplus (see Just and others 1982 for a review). Consumer surplus measures the (theoretical) willingness of non-marginal consumers to pay more than the market price for the quantity consumed at equilibrium. Producer surplus is the return to producers whose marginal cost of production is below the equilibrium market price: in other words, short-term quasi-rent. Changes in consumer and producer surplus can be used, with some caution, as measures of the benefits accruing to participants in a market as a result of a policy decision (Willig 1976).

These measures of social welfare in a market are illustrated in Fig. 1. Consumer surplus in the area under the demand curve, D, and above the (original) equilibrium price,

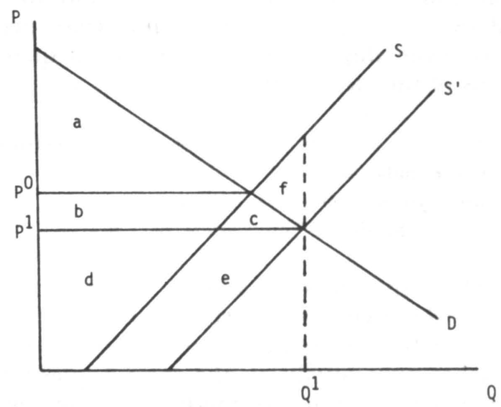

Figure 1. Consumer and producer surplus measured in one market.

P^0, equal to area (a). Producer surplus is the area above the initial supply curve, S, and below the equilibrium price line, equal to area (b + d). If a policy instrument causes the supply curve to shift to S', consumer surplus increases by area (b + c), and producer surplus changes by area (e − b). The net welfare gain in the market is area (c + e). The public cost of the shift to S' is area (c + e + f); this is the total expenditure necessary to induce producers to supply quantity Q^1 at price P^1. When complete market adjustment to intervention is as shown in Fig. 1, area (f) is the "deadweight loss" to society (Just and others 1982). This is the amount by which the social cost of intervention exceeds the distribution of benefits to producers and consumers in the market.

The benefit component of the net change in aggregate social welfare is the sum of the change in producer and consumer welfare. Stumpage supply policy instruments operate through stumpage (raw material) markets, making this the logical place to measure surplus, but producer and consumer welfare measured in product markets will be affected also. However, surplus can be measured at any market level when vertically related markets are involved, and the change in total sector welfare will be computed (Just and others 1982). In the following empirical analysis, stumpage market surplus changes are used because they provide estimates of the distribution of welfare gains and losses among producers and consumers in stumpage markets, while still accounting for welfare impacts in higher markets.

There are both public and private costs that must be considered when computing the net change in social welfare. Public costs are the direct public expenditures required to bring about the corresponding benefit, as well as the (indirect) cost of revenue foregone when public stumpage is sold at lower market prices. Private costs include the non-public share of forest management expenses, borne by other private stumpage suppliers, and net investment in stumpage processing capacity, borne by consumers in the stumpage market. The ratio of the sum of benefits to the sum of costs provides a measure of the aggregate performance of this policy instrument.

Any delay between the implementation of a policy and the realization of benefits makes this welfare analysis more complex, and a significant delay is an inescapable characteristic of many forestry policies, especially those designed to increase future timber supplies. In order to make expenditures and benefits comparable, they must be discounted to the year when the policy decision is being considered. However, this requires further assumptions.

Identifying an appropriate social discount rate (or range of rates) requires assumptions about public preferences regarding the intergenerational transfer of resources. "Resources" refers to public expenditures as well as to physical resources (timber). The discount rate is a measure of society's rate of time preference for consumption. A high discount rate expresses a preference for consumption in the near future, while a low discount rate indicates a willingness to defer consumption in the near future in favor of consumption by future generations. An additional assumption, for analytical convenience, is that a single rate is valid for the entire period under investigation.

The derivation of a valid measure of the change in social welfare attributable to a particular forest policy instrument requires that future market conditions be estimated both with and without public intervention. In order to correctly estimate the "with and without" consequences of a timber supply policy instrument, the instrument must be one element in an analytical structure that links short-run and long-run supply. Stumpage and product market developments must be projected in the absence of the use of the instrument in order to establish a "base" against which subsequent projections, with varying types or levels of intervention, can be compared.

Producer and consumer surplus in stumpage markets

Fig. 2 illustrates short-run supply and demand relationships in stumpage markets in a single region. The aggregate stumpage supply curve (S^T) is composed of the horizontal summation of supply curves for other private, forest industry, and public owners of stum-

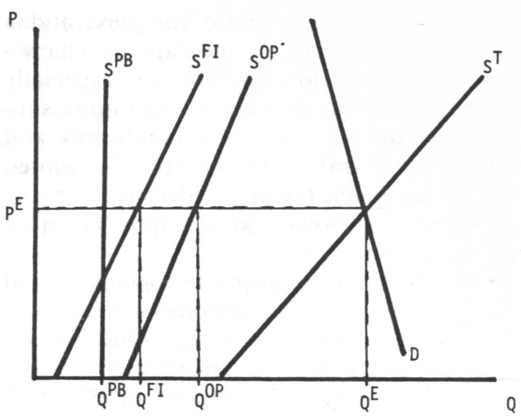

Figure 2. Short-term supply and demand in the stumpage market in one region.

page, indicated as S^{OP}, S^{FI}, and S^{PB}, respectively. The supply of stumpage from other private and forest industry owners is assumed to display the normal price-quantity relationship: supply increasing with price.[2)] A number of studies have observed this positive correlation between timber harvest by private owners in the United States, and the market price of stumpage (see for example, Adams and Haynes 1980, and Binkley 1981).

In Fig. 2 public stumpage supply is price-inelastic because public harvests are determined by policies that are relatively inflexible in the short-run, and (generally) not responsive to short-run changes in price. In future periods this short-run, price-inelastic curve may shift out or back, as public timber supply policies change, or as the budgets to implement them change.

The demand for stumpage, labeled D, is derived from product supply relationships in the region, aggregated over all producers and products. The stumpage demand curve in Fig. 2 represents the demand for stumpage as a factor in the production of lumber, plywood, and other products. Changes in the price (cost) of stumpage lead to movements along this factor demand curve; a change in the cost of any other factor of production will shift the derived demand for stumpage. In competitive equilibrium all suppliers receive the same price, P^E, and total supply in the market is $Q^E = Q^{PB} + Q^{FI} + Q^{OP}$.

In the southern United States, the location of the aggregate (regional) stumpage supply function is determined in large part by the contribution of other private owners. Forest industry owners of stumpage contribute an important, but smaller share of the aggregate supply function. The public contribution to southern timber supply is small. Fig. 2 illustrates the structure of stumpage markets in the southern United States. In the western United States, public owners are dominant in stumpage markets. Forest industry is the next most important participant; other private owners make the smallest contribution to aggregate stumpage supply in the western United States.

Timber supply policy instruments that target the supply of one stumpage owner group will not only redistribute benefits (surplus) between producers and consumers, but will also reallocate total producer surplus between stumpage owners. Because stumpage markets exhibit strong regional differences, but product markets are more homogeneous, a targeted stumpage supply policy also leads to an inevitable redistribution of benefits between regions, as well. These distributional impacts are not often considered when policy instruments are evaluated; however, these secondary effects are important, and concern for them may underlie policy decisions.

Partial and full market adjustment

Partial market adjustment to a policy-induced shift in other private stumpage supply in one region is illustrated in Fig. 3. This adjustment is partial because it does not account for any subsequent changes in stumpage demand that can be attributed to the shift in supply. In Fig. 3, the entire shift in market supply to $S^{T'}$ is attributable to the shift in other private supply. Market price declines to P^1, and the increase in the quantity supplied by other private owners more than offsets the decrease in timber supplied by forest industry, and public owners. There is an increase in consumer surplus, a reduction in forest industry's producer surplus, and a decrease in public revenue from stumpage sales. Other private owners may or may not realize a gain in surplus as a result of the shift in supply. The welfare of the forest industry as a producer of stumpage declines, but the forest industry realizes gains as a consumer of stumpage.

2) Increasing marginal cost stumpage supply curves such as S^{OP} and S^{FI} are not complete raw material supply curves because they do not include harvesting, and stump-to-mill transportation costs. This analysis is valid with either type of supply curve, however.

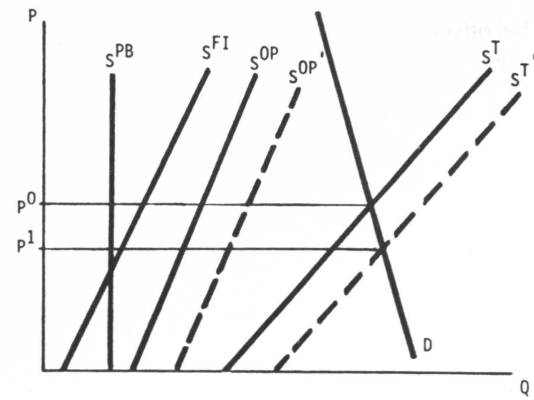

Figure 3. Partial market adjustment to a shift in other private stumpage supply in one region.

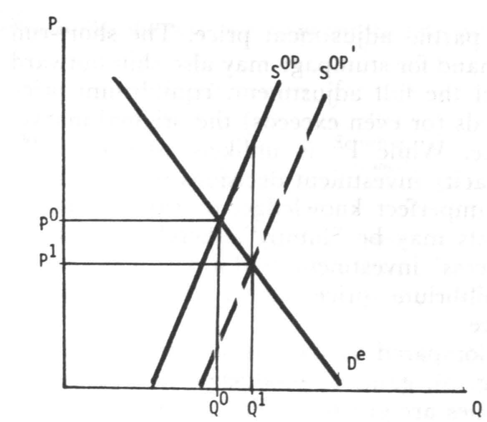

Figure 4. Derived demand for other private stumpage and "deadweight loss" in the partial adjustment case.

In Fig. 4 the change in other private supply shown in Fig. 3 is isolated, and shown with the excess demand for other private timber, indicated as D^e. The excess demand for other private timber is computed by subtracting the quantity supplied by forest industry and public owners from the market demand curve (at every price). The price impact of the shift to $S^{OP'}$ is same in Fig. 3 and Fig. 4. The shaded area of Fig. 4 indicates the "deadweight" social welfare loss attributable, in this case, to the intervention that causes the shift in other private supply.

However, Figures 3 and 4 are based on partial market adjustment. Fig. 5 shows a full adjustment to the stumpage market policy instrument, in which both the other private supply function, and the stumpage demand function have shifted. The derived demand function has shifted because stumpage consumers in this region have increased their capacity to process timber into products, in response to relatively less scarce raw material. An increase in processing capacity will alter the marginal cost of production, thereby shifting the product supply function; this, in turn, shifts the derived demand for stumpage.

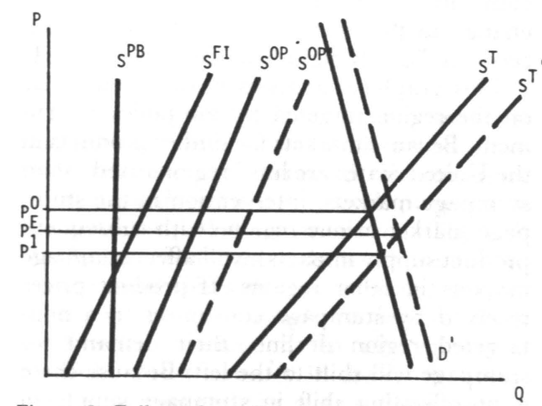

Figure 5. Full market adjustment to a shift in other private stumpage supply in one region.

Fig. 5 illustrates one possible outcome of this full adjustment, in which the equilibrium price, P^E, lies between the original price and the partial adjustment price. The short-run demand for stumpage may also shift outward until the full adjustment, equilibrium price equals (or even exceeds) the original market price. While P^E is unlikely to exceed P^0, capacity investment decisions may be based on imperfect knowledge, or capacity increments may be "lumpy", thereby leading to "excess" investment, and a post-intervention equilibrium price higher than the initial price.

Compared to the partial adjustment case (Fig. 3), gains to producers, and public revenues are greater in Fig. 5 (losses from the "base" in Fig. 2 are reduced). The change in consumer surplus in comparison to the partial adjustment case is uncertain, but as long as P^E is less than (or equal to) P^0, consumer surplus is unambiguously greater than in the base. When full adjustment has taken place, gains to consumers plus the revised (net) change in producer welfare, may easily exceed the "deadweight loss" in Figs. 1 and 4.

This graphical analysis has focused so far on the region targeted by the policy instrument. Because markets for timber products in the United States are less "regionalized" than stumpage markets, intervention in the stumpage market in one region (with subsequent product supply impacts), will affect stumpage markets in other regions. If product prices received by stumpage consumers in a non-targeted region decline, their demand for stumpage will shift to the left. Because there is no offsetting shift in stumpage supply in this region, the result is a reduction in both consumer and producer surplus.

Cost-share payments made to other private owners in the southern United States can be expected to have a negative impact on producer and consumer welfare, and public timber sales receipts in the western United States. Forest industry suppliers of stumpage in the South can be expected to suffer a similar welfare reduction, and public timber sales receipts in this region will also decline. Stumpage consumers in the South should realize an increase in welfare, but the welfare impact on other private stumpage suppliers is uncertain. A redistribution of welfare is an inevitable outcome of this intervention in stumpage markets, but only an empirical analysis can establish whether the losses to some participants (and regions) are likely to be offset by gains to other participants and regions. In addition, an empirical analysis must determine whether any positive net gain exceeds the social cost of this policy instrument.

Welfare impacts of forestry cost-share payments

Estimating the welfare impacts of forestry cost-share payment requires the development of an analytical system in which: a) the response of other private owners to the policy instrument is measured; b) the effect of this response on stumpage supply is determined; and c) the subsequent impact on regional stumpage and product markets is computed. With such a system, a change in cost-share payments, holding all other market influences constant, can be translated into changes in the welfare of market participants.

Brooks (1985) describes this policy analysis model in some detail. It consists of a plantation-response model in which the reforestation behavior of other private owners in the southern United States is a function of cost-share payments (in any program) and planting costs. Plantation establishment is linked to long-term inventory development through an age-class, yield table projection model. This inventory projection model has the important feature of being able to simulate forest development in the absence of active reforestation. Finally, changes in timber inventory affect short-run stumpage supply by shifting the function outward (increases in inventory) or backward (decreases in inventory). This relationship is part of the spatial equilibrium, market-simulating Timber Assessment Market Model (Adams and Haynes 1980).

The Timber Assessment Market Model (TAMM) is a model of North American softwood lumber, plywood, and stumpage markets. Nine supply regions are identified, including two in the southern United States, and four in the western United States. Stumpage supply relationships take into account differences among public, forest industry, and other private owners of timber. Stumpage supply by private owners is represented as a function of stumpage price and the owner group's timber inventory. Changes in timber inventory shift the owner group's stumpage supply when this function is expressed as a price-quantity relationship (as in Fig. 2). In TAMM, long-term timber supply is a sequence of intertemporaly-linked, short-term supply relationships; timber inventory projections provide the linkage mechanism. Regional stumpage demand is derived directly from product supply functions. Adams and Haynes (1980) describe TAMM in detail, including simulations of the long-term development of stumpage and product markets.

The following analysis of the welfare impact of cost-share payments is a revision and extension of the benefit-cost evaluation reported by Brooks (1985), using the cost-share payment, policy-response model incorporated into TAMM. Table 1 shows the changes in welfare, measured by producer and consumer surplus in stumpage markets, that are the result of an increase in cost-share payments in the southern United States. In this simulation, payments (in all programs) are increased to 66 million dollars a year from the "constant-payments" level of 13 million dollars a year, beginning in 1982. The values shown are computed from the change in projected surplus, over the period 1982–2016, discounted to 1982 and summed to a single, present net value. A negative value indicates a reduction in welfare. Table 1 shows clearly the uneven distribution of welfare gains and losses in stumpage markets.

Table 1. Present value of the change in stumpage market welfare attributable to an increase in cost-share payments in the South.[a)]

Discount rate[b)]	Producer surplus[c)] Total West	FI South	OP South	Consumer surplus West	South	Total welfare change[d)]
	Million 1967 $					
2	–2418	–6874	–1099	–4722	17033	1921
4	–1383	–3860	–377	–2712	10095	1763
6	–806	–2204	–54	–1585	6120	1471
10	–291	–755	121	–566	2403	911

a) Cumulative change in surplus 1982–2016, discounted to 1982; negative values indicate a welfare loss.
b) Real interest rate (all values are constant 1967 dollars).
c) FI= forest industry; OP= other private; West includes all private owners.
d) Sum of producer and consumer surplus, all regions.

Producers of stumpage in both the west and the south incur a welfare loss when cost-share payments are increased, and stumpage prices are reduced from the levels projected in the constant-payments simulation. The welfare loss to producers in the south is approximately three times the loss incurred by producers in the west; nearly 70 percent of the total welfare reduction (in all regions) is borne by forest industry in the south. Stumpage consumers in the west suffer a welfare loss, but stumpage consumers in the south realize large gains in welfare. It is important to note that these "losses" to producers and western stumpage consumers are actually the result of a failure to realize gains projected in the constant-payments simulation.

In this analysis any change in welfare is based on a comparison of the results of a continuation of current strategy (i.e., constant-payments), and an alternative strategy (increasing cost-share payments). Only the level of cost-share payments distinguishes these strategies. In both simulations, prices and quantities change, over time, as a result of the dynamic structure of the model. There is a distinction, then, between projected gains or losses in timber harvest or production over time within a simulation, and estimates of welfare change when the high-payments strategy is compared to the constant-payments strategy. Adams and others (1977) use the phrase "alternative developmental path" to describe market simulations of the type conducted here.

When cost-share payments remain constant, stumpage prices in the south are projected to rise rapidly as a result of a steady backward shift in other private stumpage supply. This shift is the result of a decline in softwood timber inventories held by these owners. Stumpage producers in all regions benefit from rising prices, but the increase in stumpage prices is greatest in the south. In the constant-payments simulation, timber harvest in the West increases over time as regional stumpage supply and demand curves shift outward. Outward shifts in the derived demand for stumpage are caused by increases in production capacity. The quantity of stumpage supplied by southern producers is smaller, over time, as other private stumpage supply curves shift backward. The derived demand for stumpage in the south shifts backward also, as stumpage consumers reduce their processing capacity in response to declining raw material supplies and higher prices.

This current-strategy "developmental path" (i.e., constant cost-share payments) is in sharp contrast to the current-strategy path described by Adams and others (1977) and the "Base" simulation described by Adams and Haynes (1980). The primary source of the difference is the methodology used to project the development of southern softwood timber inventories in each of these models. Adams and others (1977) and Adams and Haynes (1980) use a stand-table projection system developed by Larson and Goforth (1974) to simulate forest inventory changes. Brooks (1985) and this study use an age-class projection model that was designed to provide a more realistic portrayal of the development of southern forests, through the use of an age-class structure and a Markov-process, regeneration-probability matrix. In this model, projections of softwood inventories are more closely linked to private forest management practices, and to the natural development of southern softwood forests in the absence of management. For more information on this inventory projection model see Brooks (1985).

When cost-share payments are increased, planting on other private forest land increases, the inventory of other private softwood timber increases and, as a result, other private timber supply increases. In this case, southern stumpage prices do not continue to increase, as in the constant-payments case, and western stumpage producers and consumers do not gain at the expense of producers and consumers in stumpage markets in the south. In a "with and without" policy analysis, the result, with intervention, is a loss of welfare in western markets, and a gain in welfare for stumpage consumers in southern markets. Projected losses and gains attributable to the market intervention are "real" to the extent that markets follow the "constant-payments" development path in the absence of any intervention.

Table 1 shows that forest industry in the south incurs a welfare loss as producer of stumpage, but realizes a gain as a consumer of stumpage that is larger than the loss, in absolute terms. Some of this gain is passed on to consumers in product markets. Forest industry in the west suffers a welfare reduction as a producer and as a consumer of stumpage, when cost-share payments are increased in the south. At discount rates below 10 percent, the present value of the welfare change for other private owners in the south is also negative; although some individuals benefit by receiving cost-share payments, and have more timber to harvest, the welfare of the group is reduced. The discount rate is significant here because of the time path of the change in welfare for other private owners in the south: this group realizes welfare (surplus) gains in the period 1995–2000, has little or no change in welfare from 2000–10, and after the year 2010 incurs a welfare loss. For all other stumpage producers, in the west and south, the welfare change is consistently negative, beginning in the period 1995–2000; as a result, the present value of their welfare change is negative at any discount rate.

The last column in Table 1 shows that, at any discount rate, the net change in welfare in stumpage markets in all regions is positive. Gains by stumpage consumers in the south easily outweigh the sum of the losses by producers in the west and south, and consumers in the west. Consumer gains in the south begin after 1995, and increase sharply after

Table 2. Present value of the change in total public and private cost attributable to an increase in cost-share payments in the South. [a)]

Discount rate	Private investment cost[b)]	Direct public cost: Total[c)]	Revenue loss[d)]: West	Revenue loss[d)]: South	Total cost	Benefit cost ratio[e)]
			Million 1967 $			
2	190	3111	2023	708	3301	.58
4	146	1849	1157	400	1995	.88
6	117	1138	675	230	1255	1.12
10	82	489	245	80	571	1.60

a) Cumulative costs 1982–2016, discounted to 1982.
b) Private share of planting cost, assuming an average cost-share rate of 66 percent.
c) Increase in cost-share payments plus revenue loss.
d) Public timber harvest times the change in stumpage price.
e) Present value of the change in welfare (from Table 1), divided by the present value of the change in total cost.

2010. Losses to all producers in the west, forest industry producers in the south, and consumers in the west mount after the year 2005. By the year 2010, other private producers in the south also incur welfare losses. The net change in producer and consumer surplus (in all regions) is positive through the year 2005, briefly negative (2008–14), and positive again as consumer gains increase faster than producer losses. At any discout rate the present value of the net change is positive.

Table 2 shows the present value of the changes in public and private costs that can be attributed to the increase in cost-share payments. The private cost component is the share of total planting cost that must be borne by the recipients of cost-share payments; this is estimated to be one-third of the total cost (that is, an average cost-share rate of 66 percent). Table 2 does not reflect the private cost of any change in processing capacity, based on the assumption that policy-induced net investment in the south will be offset by a reduction in investment in the west. In addition, the major impact of market intervention on processing capacity in the south is to prevent disinvestment. In the constant-payments simulation there is disinvestment in processing capacity in the south, accompanied by an increase in capacity in the west. In the simulation in which cost-share payments are increased, the increase in stumpage prices is moderated, and the disinvestment in southern processing capacity does not occur; production capacity in the west increases by a smaller amount in this simulation.

The direct public cost of an increase in cost-share payments has two parts: 1) the cost-share expenditures themselves; and 2) the revenue loss resulting from lower stumpage prices. Because public owners are important participants in stumpage markets, especially in the west, revenue loss is an important addition to the "balance sheet" for this intervention. Brooks (1985) does not consider public revenue loss in evaluating cost-share payments. Table 2 shows that in the simulation of higher cost-share payments, the loss of revenue to the public from the sale of stumpage at reduced prices is far greater than the increase in direct payments.[3] These components of the cost of intervention also differ in terms of the sensitivity of their present value to the discount rate chosen for the analysis. The change in cost-share expenditures and associated private costs is constant over the projection period, by assumption, and begins in year 1982 of the simulation; revenue losses do not occur until after year 1995, and increase steadily as the market

[3] Indirect costs (or benefits) to the public, such as changes in tax revenues, are not considered in this analysis.

intervention has a greater impact on stumpage price in all regions.

The last column of Table 2 shows the ratio of the present value of the net benefit of intervention (from Table 1) and the cost of intervention, at each discount rate. Costs exceed benefits at discount rates below 5 percent; at discount rates above 5 percent this market intervention can be justified. The relationship between the discount rate and the benefit-cost ratio shown in Table 2 is the inverse of that reported in Brooks (1985). The inclusion of public revenue loss as a social cost, in this study, is the source of the difference. At higher discount rates this additional cost contributes less to the present value of total cost, and the results here are similar to those reported in Brooks (1985).

At real discount rates above 5 percent this type of market intervention has aggregate benefits that exceed aggregate costs. However, benefits are distributed to stumpage consumers in the south at the expense of stumpage producers, and stumpage consumers in the other regions. Public costs are not restricted to those directly associated with carrying out the intervention, but also include foregone revenue. Although the intervention is appropriate at reasonable real discount rates, these indirect costs and impacts may be inconsistent with the programs or policies of other public agencies or policymakers.

Comparing policy instruments

The change in social welfare computed in the previous section was based on the assumption that public timber harvest is the same in the simulation of "high payments" projection as in the constant-payments projection. Public harvest is set, in general, by policies that are fixed in the short-run, but flexible in the long-run given sufficient expenditures on public forest management. An increase in public harvest (shifting S^{PB} to the right) can lead to the same price impact as expenditures in programs to shift other private supply. That is, the shift in aggregate supply to $S^{T'}$ (in Fig. 5) and, eventually, the change in market price to P^E, can come about through a shift in S^{PB} with no change in S^{OP}. Although the outcome will be the same in terms of price, the distribution of gains and losses between producer groups and regions will be quite different in this case.

Adams and others (1977) examine the prospective welfare impacts of efforts to affect prices through changes in National Forest harvests, using an approach similar to the one used here. In their analysis, summarized below, the policy instrument is the level of federal (USDA Forest Service) timber supply, and their conclusions are consistent with the conceptual framework described earlier. Because federal timber ownership is concentrated in the west, stumpage markets in this region will be affected directly, while those in the south will be affected through resulting changes in product markets. This is a reversal of the regional impact of the cost-share payment instrument.

When public harvest is increased in the west, private stumpage producers in the west and south suffer a loss in welfare (relative to the base projection), with those in the west incurring the greater loss (Adams and others 1977). Stumpage consumers in the west realize a gain, while stumpage consumers in the south incur a loss. The welfare of forest products consumers is increased, and USDA Forest Service timber sales receipts increase. State and county tax revenues decline as stumpage prices fall, because the value of private timber inventories decreases. The change in variable costs associated with increased National Forest harvests is considerably less than the gain in social welfare. As a result, the net welfare impact of price stabilization pursued through increasing federal timber supply is positive.

The policy instrument considered by Adams and others (1977) is different from that in the cost-share payments case, in that the change in public harvest does not require an investment. They report the welfare impacts as constant dollar amount, in terms of deviations from the "current strategy" welfare level. This welfare change is not discounted to the time of first implementation of the strategy because benefits and costs occur contemporaneously. However, the time path of the projected welfare change is similar to that observed with the cost-share payments instrument: the net welfare gain is substantially greater by the year 2000 than it is in the year 1980, increasing by a factor of ten over this period.

The timber-supply policy instruments examined by Adams and others (1977) and Brooks (1985) would be directly comparable if an investment had been required in order to relax the policy-determined public harvest level in the Adams and others (1977) study. This investment might be for timber management (on public land), or it might be required in order to increase the production of the nontimber forest resources whose output is reduced on harvested public forest land. Nevertheless, these policy instruments are directly comparable in terms of their market impact: they are intended to affect price, over time. Because of this, these alternative instruments can be seen as two inputs in the "production" of a single policy outcome. The outcome is measured, in this case, by the level of future prices.[4]

This multiple-input, single-output production function analogy can be extended in order to provide a basis for comparing alternative policy instruments. This analytical framework can then be used, for example, to determine an optimal allocation of an agency's (or agencies') budget.

A production isoquant is the locus of all combinations of inputs that yield a specified level of output; a "policy isoquant" is (in this case) the locus of combinations of expenditures on alternative instruments that yield a specified level of price impact. A hypothetical policy isoquant is illustrated in Fig. 6. Each axis in Fig. 6 measures expenditures on policy instruments PI_1 and PI_2; I° is the isoquant mapping of the combination of expenditures on instruments PI_1 and PI_2 that yields a constant market (price) impact. The agency (or public) budget constraint is indicated as line BB. The expenditure combination (e_1, e_2) provides the greatest market impact for this budget; equivalently, (e_1, e_2) is the minimum

[4] Adams and others (1977) point out that the price effect can be measured in either stumpage or product markets, depending on the preferences of the policy maker(s).

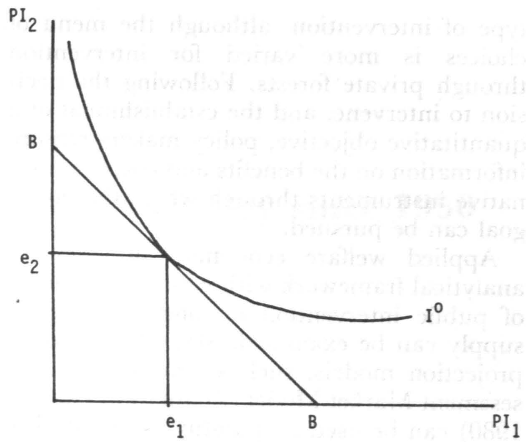

Figure 6. A hypothetical policy isoquant.

budget necessary to achieve the impact implied by I°.

Isoquant I° in Fig. 6 may reflect the desired impact of intervention, measured in terms of prices; however, the associated distributional consequences may be less than satisfactory. Any movement from point (e_1, e_2), while remaining on the budget constraint BB, implies an isoquant with a lower level of (aggregate) market impact; however, this also implies changes in the regional and distributional impacts. Once point (e_1, e_2) has been established, movements in either direction (along BB) can be explored for their distributional impacts. The policy isoquant framework provides a mechanism for determining the budget allocation that provides the maximum market impact for a fixed budget, subject to an acceptable set of distributional consequences.

Summary

The adequacy of future timber supplies is one of the traditional concerns of forest policy at the national level in the United States. Public opportunities to intervene in timber markets fall into two broad categories: programs directed at private forest land, and programs affecting public forest land. Within each category there are further choices of the type of intervention, although the menu of choices is more varied for intervention through private forests. Following the decision to intervene, and the establishment of a quantitative objective, policy makers require information on the benefits and costs of alternative instruments through which the policy goal can be pursued.

Applied welfare economics provides an analytical framework with which the benefits of public intervention in long-term timber supply can be examined. Market-simulating projection models, such as the Timber Assessment Market Model (Adams and Haynes 1980) can be used to quantify future market conditions, both with and without policy intervention. The spatial characteristics of TAMM are especially useful in estimating the distribution of the benefits and costs of intervention among major producing regions in the United States, and among participants in markets.

Public intervention through forest management, cost-share expenditures in the southern states, are shown to have strong distributional impacts; welfare gains accrue to stumpage consumers in the south, while welfare losses are borne primarily by participants in western markets. An analysis of the welfare impact of public timber harvest policy shows a similar impact on future prices, but a different distribution of benefits and costs (Adams and others 1977). Optimal market intervention requires a blend of types of intervention that provides an adequate level of impact (subject to a budget constraint), along with a satisfactory distribution of gains and losses. A policy isoquant is proposed as an analytical device through which this can be done.

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