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Distributive Effects of Forest Service Attempts to Maintain Community Stability

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ABSTRACT. Community stability is an objective of USDA Forest Service timber sales. This paper examines that objective, and the success the Forest Service can have in attaining it, through its intended maintenance of a constant volume timber harvest schedule. We apply a three-factor, two-sector modified general equilibrium model with empirical evidence from the timber-based counties of western Montana. Departure from a market responsive timber policy can have positive impacts on the wood products sector, but the net effects on the local community are very small. The costs to the public treasury of pursuing such a policy dwarf these small community benefits. FOR. SCI. 37(1):245–260.

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TIMBER SUPPLY FROM PUBLIC LANDS has again become a contentious policy issue. Log truck convoys symbolizing solidarity within the wood-products industry have become regular media fare in the northwestern United States, and yellow ribbons symbolizing dependence on wood products have become common ornaments. One reason this debate is so persistent and emotional is the effect changing timber supplies can have on local economies. The USDA Forest Service has a long tradition of sensitivity to the people who depend on wood products for their livelihoods (Clary 1986). "Community stability" is the Forest Service expression for its objective to maintain the integrity of small, typically western, communities that depend on public timber harvests. This objective is consistent with both aggregate public policies designed to minimize the social costs of cyclical economies and general public concern for the welfare of local populations caught in the boom-and-bust towns often associated with natural resource industries. Nevertheless, local populations feel that decisions regarding roadless areas and habitat for endangered species threaten their jobs and reflect agency insensitivity.[1]

Forest Service options in pursuit of community stability are limited because it is a land management agency, not a social welfare agency. Since the policy in-

[1] Adequate historical review of the Forest Service's community stability policy exceeds the authors' ability and probably our readers' time. Concerns for community welfare are as durable as any in the Forest Service, but economists' criticisms have been no less so. Schallau and Alston (1987) is a balanced and synthetic history of the policy and, with its 206 citations, is certainly thorough.

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struments it can employ are equally limited, the timing and quantity of public timber sales have become the primary tool. The Forest Service posits that in the presence of externally generated instability, such as cyclical housing demand, a constant flow of public timber provides stability for both the local mills that process public timber and the local communities for which the mills are a major industry. This policy is reflected in a letter written by the Chief of the Forest Service in May of 1985 (Peterson 1985):

> As a general rule, the timber sale program on a National Forest should be managed so that total benefits equal or exceed the costs over time. Exceptions may be appropriate where there are overriding considerations such as the need to control insect and disease outbreaks or maintain the stability of dependent communities. For example, the livelihood of a dependent community should not be threatened by a short-term downturn in the timber market which adversely affects the short-term economics of the timber sale program.

The policy design calls for an even annual flow despite externally imposed instability, such as, short-term downturns in the timber market. It is unclear that an even flow of timber sale offerings can translate into an even flow of timber harvests. Indeed, previous research indicates that Forest Service harvests have, in some instances, been more variable than private harvests (Jackson and Flowers 1983). We do not, however, examine the effectiveness of the policy. Instead we examine the extreme case, a policy perfectly successful as designed and examine the local economic effects if the Forest Service successfully guarantees a fixed harvest level flowing to local mills.

It is clear that the self-image of many rural communities in the West depends on the wood products industry, but it is unclear whether such communities are similarly economically dependent on even flows of Forest Service Timber.[2] Economists may observe that a fixed input flow is a strange way to obtain stability of either output or welfare. Indeed, a counter-cyclical input flow may be necessary to offset aggregate economic shifts. The optimal economic policy is not our concern, however, because our focus is the impacts of the intended Forest Service policy. The paper shows that an even-flow harvest could stabilize wages and employment in the wood products sector. The net effect on all sectors of the local community would be small, and results are insensitive to a range of assumptions about factor substitution and labor supply. Furthermore, any success that the policy would produce would come only at considerable cost to the public timber management budget and ultimately the federal treasury.

Our conclusions rely on a two-sector, three-factor general equilibrium model first introduced by Harberger (1962, 1966). There is a large general equilibrium literature in public economics, much of it dealing with tax incidence (McClure 1975, Atkinson and Stiglitz 1980), and in international trade theory (Caves and Jones 1985). This method has been applied to some extent in natural resources: to farm programs by Hertel and Tsigas (1987), to energy subsidies (Hertel 1988), and to tax incidence in the forestry sector by Boyd and Daniels (1985). Our analysis is very much an extension of the tax incidence literature because an

[2] Social scientists other than economists argue that the Forest Service approach is unrealistically narrow, aside from any effectiveness issue. Machlis and Force (1988) review the community stability literature with particular interest in measures of community and stability and conclude that a stable industry is not necessarily synonymous with a stable or healthy community.

even-flow policy is operationally equivalent to a negative tax designed to vary such that quantity remains constant. Our model is conceptually similar to that of Hertel (1988), though they were developed independently.

General equilibrium modeling should be viewed as an alternative to the input-output/economic base models developed by regional economists and commonly applied to forestry (see variously Alward and Palmer 1983, Polzin et al. 1988, and Connaughton et al. 1985). While none of these methods is perfect, the general equilibrium approach is superior to the input-output (I-O) approach for our purposes because of its ability to examine economic change resulting from exogenous shocks. The strength of I-O models is in measuring economic impacts, but they are based on a fixed economic structure and cannot, therefore, be used to consider the flows of workers or capital between sectors as direct results of fluctuating marginal productivities. These are our main points of interest. Moreover, Schuster and Medima (1989) tested the predictive accuracy of I-O and economic base models by applying them to 1973-1982 data from Montana and Idaho and comparing the predictions with the actual economic activity. Their conclusion was that neither model consistently predicted total employment (their main variable of interest) more accurately than a simple "no change" scenario, even though total employment increased approximately 40% during the study period. General equilibrium models are not without critics, however, who often focus on the lack of adequate data that can force the use of somewhat arbitrary parameter estimates. This can be mitigated by analyzing sensitivity of results to different parameter levels.

It is reasonable that a policy designed to aid the timber sector of a local economy would be able to aid that sector, but it is much harder to anticipate the aggregate effects on the local economy. When the wood products sector slumps, do mill workers keep working in the same jobs but at lower wages, do they work in other industries, or do they become unemployed? What is the aggregate wage income under each scenario? General equilibrium models can be used to begin addressing these and similar questions by imposing and then relaxing various employment assumptions.

The eight northwestern Montana counties and the years 1968-1981 provide evidence for the case study. Our focus on Montana means that we are examining Forest Service policy as it relates to forestry's extensive margin. The mills and communities in this area are both small, particularly when compared with those in the Pacific Northwest, where a somewhat different community stability debate is ongoing. In Montana, the community stability question is "Will there be a timber industry?," while in the Pacific Northwest, the issue is "How large and profitable will the timber industry be as it moves away from its dependence on large, typically old-growth, timber?" The low biological productivity, steep sites, and high transportation costs all combine to make Montana's timber industry marginal, while often making timber management an unprofitable endeavor for the Forest Service (GAO 1984, Bolle 1986, and O'Toole 1988).

Wear's (1985) translog estimates of the wood products industry's cost function for Montana are the basis of our modified Harberger model. We use this specification to contrast the impacts of simulated market-sensitive public timber harvests with those from fixed harvest levels that ignore local lumber price changes, which during our 14-year study period were as large as 18% from the mean. There is reason to doubt that the Forest Service would ever be truly market sensitive, even if its community stability policy ended. The lack of economic incentives and the agency's broad mission may preclude economically efficient behavior. Similarly, there is doubt that the Forest Service could ever provide truly constant timber supply to the mills. The Forest Service can only offer the timber for sale: it may go unsold; or once sold, it may be stored either on the stump or in unprocessed inventory (Adams and Haynes 1989). Nevertheless, comparing perfect market sensitivity versus fixed timber harvest gives the community stability policy the maximum possible effect.

Our approach limits our focus to the short- to intermediate-run period, perhaps 3 to 7 years. This means that technology shifts are less important than they would be over a longer period, and that we cannot address the questions of very long-term community and forest stability, which would be desirable given Forest Plans that project harvest levels for up to 200 years. Forest Service regulations anticipate a 10- to 15-year planning cycle, and all Forest Plans must be reviewed at least every 5 years for changes in demand. Moreover, our analysis period is shorter than the lifetime of a mill and at least as long as a business or building cycle. This is a period over which existing capital in the wood products industry is relatively inflexible and labor may be mobile between intracommunity sectors but tends to exhibit intercommunity immobility. It also represents the longest period we feel comfortable modeling, given the limitations of general equilibrium models vis-a-vis technical change.

We assume furthermore that the community sells its wood products in an external market and that its wood products industry receives an exogenous downward adjustment in demand for its product. The Forest Service responds by maintaining a fixed flow of stumpage, even though that would presumably reduce the price it receives and may produce below-cost timber sales (Daniels and Daniels 1986). It thereby intends to absorb a large share of the cyclical economic effects itself.[3] We examine the effects this timber harvest policy can have on social welfare, measured in terms of community income and employment.

A MODEL OF THE COMMUNITY

We follow the approach of Caves and Jones (1985) who consider the elements of the single community's general equilibrium system characterized by its equations of change. Thus, we consider changes in demand for the product relative to exogenously determined changes in product prices and, on the supply side, changes in product supply relative to changes in factor shares and changes in factor inputs relative to changes in factor prices.

Citizens of the aggregate economy consume two goods, wood products X and a generalized all-other-goods Y. Prices of both are set in the external economy. The local economy is a price taker with respect to each, so that

[3] This policy may be wise if the demand shift is temporary and cyclical. If the shift is permanent, then a wiser policy would introduce a smooth decline in Forest Service timber inputs, thereby easing the transition to a permanently smaller level of wood products outputs. Otherwise, the Forest Service can only succeed in either (1) introducing a permanent subsidy for a declining industry, or (2) postponing an eventual precipitous adjustment. It is a point of fact that easing transitions and smoothing declines are not actions which are consistent with the current Forest Service policy which this paper examines.

$$\hat{p}_Y = 0, \ \hat{p}_X = -c \tag{1}$$

The hats signify logarithmic differentiation (i.e. $\hat{p}_Y = dp_Y/p_Y$). The market for all goods other than wood products is stable, and the market for wood products has just received a cyclically destabilizing price shock, $-c$.

On the supply side, our community produces X with three factors, capital K, labor L, and stumpage S; and Y with only capital and labor. Both industries are competitive and operate under conditions of constant returns to scale. These common and reasonable assumptions permit us to write the conditions for changes in product supply relative to changes in factor shares as

$$\hat{X} = \theta_{KX}\hat{K}_X + \theta_{LX}\hat{L}_X + \theta_{SX}\hat{S}_X \tag{2}$$

and

$$\hat{Y} = \theta_{KX}\hat{K}_Y + \theta_{LK}\hat{L}_Y \tag{3}$$

where θ_{ij} is the initial share of factor i in the total cost of producing output j (e.g., $\theta_{KX} = r_X K_X / p_X X$). The conditions of competition and production functions which are homogeneous of degree one also permit us to determine the changes in factor inputs relative to changes in factor prices:

$$\frac{d(K_Y/L_Y)}{K_Y/L_Y} = \sigma_{KL-Y} \frac{d(r_Y/w)}{r_Y/w} \tag{4}$$

where σ_{KL-Y} is the substitution elasticity between capital and labor in the production of Y, and 7 and w are the unit costs of capital and labor respectively. Equation (4) can be written as

$$\hat{K}_Y - \hat{L}_Y = -\sigma_{KL-Y}(\hat{r}_Y \quad \hat{w}) \tag{5}$$

Similarly,

$$\hat{L}_X - \hat{K}_X = (1 - \theta_{SX})\sigma_{LK-X}(\hat{r}_X - \hat{w}) + \theta_{SX}\sigma_{LS-X}(\hat{s} - \hat{w}) - \theta_{SX}\sigma_{KS-X}(\hat{s} - \hat{r}_x) \tag{6}$$

$$\hat{L}_X - \hat{S}_X = (1 - \theta_{KX})\sigma_{LS-X}(\hat{s} - \hat{w}) + \theta_{KX}\sigma_{LK-X}(\hat{r}_X - \hat{w}) - \theta_{SX}\sigma_{SK-X}(\hat{r}_X - \hat{s}) \tag{7}$$

$$\hat{K}_X - \hat{S}_X = (1 - \theta_{LX})\sigma_{KS-X}(\hat{s} - \hat{r}_X) + \theta_{LX}\sigma_{KL-X}(\hat{w} - \hat{r}_X) - \theta_{LX}\sigma_{SL-X}(\hat{w} - \hat{s}) \tag{8}$$

where s is the unit stumpage price and σ_{ij-X} are Allen partial substitution elasticities. Equation (8) is the difference between Equations (6) and (7). Therefore these three equations are linearly related and we can use any two of them.

We also know that, under conditions of competition with constant returns to scale, factor payments just exhaust total receipts in each industry.

$$p_Y dY + Y dp_Y = w dL_Y + L_Y dw + r_Y dK_Y + K_Y dr_Y \tag{9}$$

Furthermore, we know that the marginal products of the factors equal the factor costs divided by the output prices (e.g., $MP_{L \quad Y} = w/p_y$).

$$p_Y dY = w dL_Y + r_Y dK_Y \tag{10}$$

Subtracting Equation (10) from (9) and dividing by Y yields

$$dp_Y = (L_Y/Y)dw + (K_Y/Y)dr_Y \tag{11}$$

or

$$BY = \theta_{LY}\hat{w} + \theta_{KY}\hat{r}_Y \tag{12}$$

Similarly,

$$\hat{p}_X = \theta_{LX}\hat{w} + \theta_{KX}\hat{r}_X + \theta_{SX}\hat{s} \tag{13}$$

Finally, the expression for Forest Service stumpage supply is

$$\hat{s}e_S = \hat{S}_X \tag{14}$$

where e_S is the supply elasticity and, if the policy is effective, then $e_S = 0$.

We now have 8 equations (2, 3, 5–7, and 12-14) and 11 unknowns (d_X, d_Y, dK_X, dL_X, dS_X, dK_Y, dL_Y, dr_X, dr_Y, dw, and ds). The underlying assumptions about our community provide conditions explaining three of these unknowns:

$$dr_Y = 0 \tag{15}$$

$$dK_X = 0 \tag{16}$$

$$dL_X = -dL_Y \tag{17}$$

The external market determines r_Y. The community is a price taker with respect to it. Capital facilities such as sawmills in the wood products industries are immobile in the short run of an economic cycle. This means that K_X is fixed and constant and that the return on capital in the local wood products industries (r_X) can vary in the community in the short run. Specifically, some of it can rest in an unemployed state during a cyclical economic downturn. The community labor supply is constant and freely mobile between the two sectors. (If community labor supply were fully mobile, it could respond to a cyclic economy by finding employment elsewhere, and the community stability problem would be much less important.) Mobility between sectors, as between logging and ranching, is consistent with observed behavior, and unemployment may not be an important problem when only one sector suffers from cyclic instability. Indeed, Stevens (1979) found a remarkable amount of employment mobility in western Oregon, both in and out of the wood products sector.

We now have the eight equations and eight unknowns from which we can estimate changes in payments to community factors of production. These payments are the important measures of community stability and social welfare. Changes in them measure the community's response to external economic stimuli.

The second step in the analysis contrasts these market responsive results with those deriving from timber harvests constrained such that their supply elasticity e_S is equal to zero. This is the extreme case where Forest Service policy is perfectly effective in maintaining an even annual harvest flow. The differences between the factor payment estimates from the two steps in the analysis measure the policy impacts on community stability.

DATA

Western Montana provides a reasonable base for displaying the empirical effects of this model. Its economy is heavily dependent on timber production and processing, and the bulk of its timber resource originates from public, and particularly Forest Service, lands. Therefore, a sudden and large external change in the price of wood products like lumber might have a sharp impact on the western Montana economy, and the Forest Service might reasonably anticipate that its timber harvests can meliorate this impact. The availability of Wear's (1985) three-factor model of the empirical relationships for Montana's wood products industry is additional reason for using western Montana to display our arguments. Table 1 records our data sources. It emphasizes our reliance on Wear's own input data and the results of his translog cost function estimates (see appendix A). Banksota, Phillips, and Williamson's (BPW) (1985) results provide confidence in Wear's estimates. BPW derive elasticity and factor share estimates for the sawmill industry in the neighboring Canadian province of Alberta. The sawmill industry is a

TABLE 1.

Data sources: the western Montana economy.

Parameter	Source
X = wood products output	value of shipments SIC 24, USDC Bur. Census (1980)
Y = all other output	value of shipments in mfg, USDC Bur. Census (1969-1982); (1980) (non-census years); plus total cash rcpts to farmers, USDA (1969-1983); plus annual sales of retail stores, USDC Bur. Census (1967-1982)
K_X, L_X, S_X = capital, labor, stumpage in X	as in Wear (1985)
θ_{iX} = share factor i in total cost of X	derived from Wear (1985)
w, $r_X = r_Y$: wages, return on capital	derived from θ_{iX} and X = $rK_X + wL_X + wL_Y + sS_X$
θ_{iY} = share of factor i in total cost of Y	aggregate U.S. value
K_Y, L_Y = capital, labor in Y	derived from θ_{iY} and Y = $rK_Y + wL_Y$
σ_{ij-K} = factor substitution elasticities in X	Wear (1985)
σ_{KL-Y} = factor substitution elasticity in Y	Klein (1974), Parashevopoulos (1979)
d_{KX} = 0, no change in capital used in X	assumption: short-run capital immobility in the declining industry
es = stumpage supply elasticity	Haynes and Adams (1985)
$d_{LY} = -d_{LX}$	assumption: full employment; labor mobile within the local community
dp_X = exogenous change in lumber price	ponderosa pine boards (no. 3, random lengths, FOB mill), USDC BEA (1980) Western Wood Products Association (1986)
$dp_Y = 0$, no change in price of all other goods	assumption: stable external economy in all other sectors

large share of Montana's wood products industry, and Wear's estimates for the latter fall within the range of the BPW estimates.

Our output measures are gross receipts because value-added data are not available for all sectors. The basic output data are statewide. We multiply them by the state population share of timber producing counties to obtain a measure of total output in these counties alone and then subtract the total output of the wood products sector (which virtually all occurs in these counties) to obtain the western Montana output for all other (nonwood products) sectors.

The stumpage supply elasticity is Haynes and Adams' (1985) private sector elasticity for the Rocky Mountain region (0.24). The private sector elasticity is preferable because, unlike the all-sector elasticity, it is unbiased by the community stability policy we wish to examine. Private sector elasticities for other regions range up to 1.2. Therefore we examine the range of values $0.24 < e_s < 1.0$ as a test for sensitivity to the Haynes and Adams' estimate. The remaining data are either explicit assumptions or common estimates of the factor-substitution elasticity for the aggregate economy. The several steps involved in deriving the factor shares in the all-other-goods industry and the imposition of a U.S. aggregate factor substitution elasticity on what may be a very different Y industry in western Montana, cause us to question their reliability. Closer inquiry, however, shows our eventual results to be insensitive to differences in the ranges $0.25 < \theta_{KY} < 0.75$, and $0.75 < \sigma_{KL-Y} < 1.25$. Therefore, we accept the derived factor shares and the aggregate factor substitution elasticity as sufficient for our purpose.

FULL EMPLOYMENT RESULTS

To this point we have assumed full employment. This may be a reasonable assumption, because unemployed wood workers tend to find alternate and seasonal employment elsewhere in the local economy. We report results compatible with this assumption first, and then examine alternative specifications. Table 2 reports the direct results from introducing these data into the eight-equation conceptual model. The western Montana economy is increasingly responsive to higher stumpage supply elasticities. That is, all variable factors and products diverge further from their initial values in response to the given change in lumber prices and more elastic stumpage supplies. In any market sensitive case, decreasing lumber prices reduces both demand for the final output of the wood products sector and demand for its factors of production. Therefore stumpage demand decreases and stumpage prices also decrease. Some capital facilities in the wood products sector become underemployed, and the return on the capital facilities in this sector drops sharply. Some local labor shifts to the Y-sector and that sector expands absolutely, absorbing some new capital from outside western Montana.

When Forest Service policy constrains the market response by holding stumpage supply constant, this policy also forces a compensating decrease in the stumpage price. This price decrease is additional to the market-induced adjustment. The larger-than-market stumpage supply combines with some otherwise underutilized capital facilities and some labor that otherwise would transfer to the Y sector. Together these factors restrict the full market responsive decline in wood products but they also prevent the full potential increase in Y-sector output.

TABLE 2.

Response of western Montana economy to an 18% decrease in the price of wood products price, given different stumpage supply responses.

Parameter and initial value	Market responsive timber supply		Constant timber supply
	(a) $e_s = 0.24$	(b) $e_s = 1.0$	$e_s = 0$
Wood products output X (million$) = 406	294.7	286.7	313.5
All other output Y (million$) = 1928	1978.0	1994.0	1965.0
Wood products employment L_X (million hr) = 19.3	15.45	14.31	16.48
All other employment L_Y (million hr) = 149	152.8	154.1	151.8
Capital in wood products K_X (billion$) = 1.202	1.202	1.202	1.202
Capital in all other K_Y (billion$) = 4.999	5.128	5.170	5.094
Timber harvests S_X (mmbf) = 1.12	1.04	0.934	1.12
Wage w ($/hr) = 8.41		—	—
Return on capital in wood products $r_X = 0.135$	−30%	−37%	23%
Return on capital in all other $r_Y = 0.135$		—	—
Stumpage price $s =$ $s = 1977$	-31%	17%	−43%

Table 3 shows the impacts of these various changes on several measures of community stability. The first measure is the apparent Forest Service measure of community stability: timber harvests which, by policy intent, are constant regardless of the aggregate substitution elasticity. The remaining measures display the social impacts of this intended policy. The policy clearly expands timber harvests, and the employment of labor in the wood products sector. It has no impact on the aggregate employment of labor, as labor only moves from one sector to the other in response to changing sector demand. Equations (12) and (15) show that the average wage in the community must remain constant. A constant wage and unchanging aggregate employment together imply a constant wage bill regardless of policy.

A satisfactory measure of aggregate community welfare is difficult to define. We might consider payments which remain in the community; that is, the aggregate wage bill plus most returns to capital. Stumpage receipts leave the community for the general federal treasury, but one-quarter of these return to local counties as a payment in lieu of local taxes from the public lands. The sum of community factor payments decreases by one-quarter of the decrease in stumpage receipts as a result of the Forest Service policy. Thus, the even-flow policy has a very small negative net effect on the community. Nevertheless, the public cost of this policy is great. Policy holds public harvests constant, which implies it

TABLE 3.

Impacts on western Montana of an 18% decrease in wood products price, comparing even flow and market responsive stumpage supplies.

Measure of community stability	Elasticity assumption	
	$e = 0.24$	$e = 1.0$
Tiiber harvests (S)	+0.08 mmbf (+7.7%)	0.19 mmbf (+20%)
Wood products employment (L_x)	+1.03 million hr (+6.7%)	2.27 million hr (+16%)
Total employment (L_x + L_y)	no change	no change
Wood products wage income (wL)	− $8.61 million (-66.7%)	$19.1 million (+16%)
Total wage income [$w(L_x + L_y)$]	no change	no change
Factor payments remaining in the community [$\Sigma(wL_i + r_iK_i) + sS/4$]	−$1.5 million (<0.1%)	−$0.75 million (<0.0%)
Public timber budgets:		
receipts foregone	$ 5.9 million	$10.6 million
additional costs	$29.4 million	$24.7 million
Total: additional net costs to US Forest Service and public treasury	$35.3 million	$35.3 million

also holds public timber costs constant at the previous market equilibrium level. The policy creates higher than (new) market equilibrium costs and lower stumpage prices, therefore lower than market equilibrium receipts. In sum, the public treasury pays a large sum (approximately one-fourth the original stumpage bill) to create a small negative impact on western Montana.

ALTERNATIVE EMPLOYMENT SPECIFICATIONS

There remains the important question of alternative employment specifications. We are also curious about alternative capital specifications.

To address these questions, we (1) introduce four different labor supply options, each of which permits some response to wage adjustments, and (2) fix the level of capital facilities in the community but permit some capital (like pick-up trucks and personal tools) to flow between the two sectors. This changes conditions (15) and (16) to

$$dK_X = -dK_Y \tag{18}$$

$$dr_X = dr_Y \tag{19}$$

and requires the addition of a labor supply function:

$$\hat{L} = e_L\hat{w} \tag{20}$$

where e_L is the elasticity of labor supply.

Boskin (1973) finds labor supply elasticities in the extreme range of $0 < e_L <$ 1.6 for various groups within the U.S. population. We treat labor supply in our two sectors independently (ii order to provide an alternative to our previous assumption that labor was fully mobile between the two sectors) and initially examine the range of values $0.5 < e_L < 1.5$ for both sectors. This range is narrower than

Boskin's because our population either does not include or is not restricted to his extreme groups (middle-aged black women and prime-aged white males). Thus,

$$\begin{aligned} &(a) \quad e_{LY} = 1.5; \quad e_{LX} = 1.5 \\ &(b) \quad e_{LY} = 0.5; \quad e_{LX} = 0.5 \end{aligned} \tag{21}$$

For further variation we consider the impact of downwardly rigid wages in the unionized wood products sector and also the possibility that skilled wood products workers are less market responsive than those workers in other sectors. There is some empirical evidence for the latter in the form of wood products workers who may choose to remain unemployed while searching for new wood products positions, rather than to accept immediately available opportunities in the other sector. Our experience does not suggest the same reluctance on the potential movement of recently unemployed Y-sector workers. Thus,

$$\begin{aligned} &(c) \quad e_{LY} = 1.0; \quad dw_X = 0 \\ &(d) \quad e_{LY} = 1.0; \quad e_{LX} = 0.5 \end{aligned} \tag{22}$$

We specify intermediate Y-sector elasticities for two alternatives. All four labor supply specifications define wages in the two sectors independently (i.e., $w_X \neq w_Y$).

Tables 4 and 5 compare our results. They are comparable to Tables 2 and 3 for the case where there is no unemployment, and labor supply is not price responsive. Tables 4 and 5 assume a timber supply elasticity $e_S = 0.24$ because, in our opinion, this is the more likely of the two alternatives reported in Tables 2 and 3.

The first two cases bracket the reasonable range of labor supply elasticity. Comparing Tables 2 and 4 shows that the elastic labor supply results bracket the labor input use, permit more capital facility flow to the Y sector, increase output in both sectors, and decrease stumpage consumption. The elastic labor supply specifications also suggest greater policy impacts: a shift from small negative aggregate community impacts (Table 3) to small positive impacts and substantially greater costs to the public treasury (Table 5). The explanation for these general results is that elastic labor supply provides more flexibility or enables more responsiveness throughout the local economy. The additional responsiveness is sufficient to permit increases in community welfare. Nevertheless, the wood products sector remains a small share of the total economy. Therefore, the net community gain is small. The additional labor supply flexibility extends its impact to stumpage consumption, permitting further decreases in stumpage consumption in the market responsive cases. The implication, borne out in Table 5, is for substantially increased public costs of implementing the policy, because the Forest Service must produce the same amount of stumpage at the same costs but receives an even lower price.

In sum, do these alternative labor supply specifications alter our initial fixed-labor supply conclusions? Not substantially. The Forest Service policy impact is important only in the case of a downwardly rigid wood products wage. Under this scenario, the policy increases market determined harvests by 17% and wood products wages and employment both by 25%. The net community wage impact, however, is negative, and the total factor payment effect remains approximately

TABLE 4.

Response of western Montana economy to an 18% decrease in wood products price, for market responsive and even-flow stumpage supply given various labor supply elasticities.

Parameter and initial value	Labor scenario							
	$e_{LY} = e_{LY} = 0.5$		$e_{LY} = e_{LY} = 1.5$		$w_X = 0,\ e_{LY} = 1.0$		$e_{LX} = 0.5,\ e_{LY} = 1.0$	
	Market	Policy	Market	Policy	Market	Policy	Market	Policy
X: $406 mm	338.4	360.9	308.6	345.1	275.2	336.4	337.0	360.4
Y: $1928 mm	1982.0	1969.0	2022.0	1988.0	2046.0	2002.0	1992.0	1976.0
L_X: 19.3 mm hrs	17.20	17.80	15.05	16.64	12.15	15.24	17.16	17.80
L_Y: 149 mm hrs	150.5	150.0	153.0	151.8	156.3	153.6	151.5	150.9
K_X: $1.202 mmm	0.89	0.96	0.81	0.93	0.78	0.94	0.89	0.96
K_Y: $4.999 mmm	5.31	5.24	5.39	5.27	5.24	5.26	5.32	5.24
S_X: 1.12 mm Mbf	1.01	1.12	0.97	1.12	0.93	1.12	1.01	1.12
w_X: $8.41/hr	6.56	7.06	7.19	7.64	8.41	8.41	6.55	7.06
w_Y: $8.41/hr	8.57	8.53	8.56	8.52	8.82	8.67	8.55	8.52
$r_X = r_Y$: 0.135	0.130	0.131	0.131	0.132	0.123	0.127	0.131	0.132
s =	−39%	−54%	−54%	−67%	−72%	−79%	−40%	−54%

TABLE 5.

Impacts on western Montana of an 18% decrease in wood products price, with an even-flow stumpage supply for various labor supply elasticities.

Measure of community stability	Labor scenario			
	$e_{LX} = e_{LY} = 0.5$	$e_{LX} = e_{LY} = 1.5$	$w_X = 0$ $e_{LY} = 1.0$	$e_{LX} = 0.5$ $e_{LY} = 1.0$
Timber harvest	+ 0.11 mm MBF (10%)	+0.15 (+14%)	+0.19 (+17%)	+0.11 (+10%)
Wood product employment	0.6 mm hrs	+1.59 (+11%)	+ 3.09 (+ 25%)	+0.64 (3.7%)
Total employment	-0.1 mm hrs	+ 0.3 (+ 0.2%)	+ 0.4 (0.2%)	-0.1 (<0.1%)
Wood products wage income	+ $12.9 mm (+ 10.2%)	+$18.8 (17.4%)	+ $26.0 (+ 25%)	+ $13.4 (+ 11.8%)
Total wage income	+ $3 mm (0.2%)	+ $2 (0.1%)	−$22 (-1.5%)	+ $4 (0.3%)
Factor payments receiving in community	+ $7.25 mm (+ 0.3%)	+ $7.75 (0.3%)	+$6.5 (+0.3%)	+ $6.25 (0.3%)
Public timber budget:				
receipts foregone	$6.9 mm	$5.4	$1.6	$7.0
additional costs	$43.6 mm	$54.4	$63.8	$43.9
Total	$50.5 mm	$59.8	$65.4	$50.9

0.3%, virtually identical with that for all other price responsive labor scenarios and only incrementally greater than the fixed labor scenarios.

CONCLUSIONS

This paper examines the Forest Service approach to maintaining economic stability in timber dependent communities by maintaining an even flow of planned annual harvest volumes. There are various reasons why the Forest Service approach is unlikely to be successful in most regions; e.g., the often small Forest Service share in local markets and many options for actual (not planned) harvest schedules by private contractors for Forest Service timber. Nevertheless, popular support for the policy remains. The most powerful policy critique accepts a policy on its own terms and shows its lack of success even on those terms. That is the approach of this paper.

In the unlikely best case, where there is no private timber supply and there are no possible inventory effects to absorb either market or policy shocks, then public agencies can create an even annual flow of stumpage harvests to the wood processing sector and the community. In the presence of severe external price shocks, this guaranteed harvest flow can have a favorable impact on wood products employment and wage income. Much of this impact is offset, however, by foregone gains in the rest of the local economy. Furthermore, the small positive impact for that timber produced in excess of the market responsive level comes at a substantial cost. This cost-seven to ten times the level of the positive local impact-would be borne by the U.S. Treasury.

Of course, an ineffective policy could still be costly. Public timber managers intend to effect community stability through timber sale timing, but the flexibility in private timber supplies and the various inventories override their intentions. In this case, the community stability policy could not have a local impact, but at least a portion of timber sale preparation costs are lost to the Treasury.

In conclusion, the Forest Service has a well-placed concern for the social hardship faced by resource-based communities as their final product prices fluctuate broadly. Translating this concern into a remedy is more difficult, and providing a constant volume flow of the basic resource is not a very satisfying solution.

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APPENDIX

Wear (1985) estimates cost share equations derived from a transcendental logarithmic cost function for the Montana lumber and wood products industries (SIC 24). The system is constrained for constant-returns-to-scale and factor price homogeneity. The structure of the three-factor model is identical to the models presented by Humphrey and Moroney (1975) for U.S. industries. Data were collected for the period 1968 to 1981. Capital and labor share and price data were derived from standard Department of Commerce sources, and stumpage data were taken from USDA Forest Service reports. Labor and stumpage share equations were estimated using Zellner's method for "seemingly unrelated equations" and coefficients for the capital equation were defined by the restrictions on price homogeneity.

Cost share estimates are:

$$\theta_{KX} = 0.7381 + 0.0730 \ln r_X - 0.0285 \ln w - 0.0445 \ln s$$

$$\theta_{LX} = 0.4281 - 0.0285 \ln r_X + 0.0970 \ln w - 0.0684 \ln s$$

$$\theta_{SX} = -0.1662 - 0.0445 \ln r_X - 0.0684 \ln w + 0.1192 \ln s$$

Allen partial elasticities of substitution were calculated at factor share means using the standard formulae: $\sigma_{KL} = 0.8221$; $\sigma_{LS} = 0.1285$; $\sigma_{KS} = 0.4491$.