Short-run Impacts of a Value Added Tax on Forest Products

by

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(ABSTRACT)

As the federal deficit rises in the United States, interest in a consumption tax system or the value added tax (VAT) also increases. This investigation attempts to determine the short-run impacts of a value added tax upon private forest management. A literature review investigates the theoretical economic impacts of a VAT and experience with the tax in other countries. Then supply and demand functions in both the southern pine sawtimber stumpage and new single-family housing sector are empirically derived. These functions are used to determine the short-run housing price elasticities of the quantity of houses sold and the price and quantity of stumpage sold. From this, the impact of a VAT-induced housing price change is determined, and simulation with different VAT rates are performed. Based on housing markets alone, it is found that a VAT is likely to cause a short-run reduction in sawtimber stumpage price and quantity demanded which is less than 1/10 percent of the VAT rate.

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INTRODUCTION

Several taxing systems in the United States affect private forest land use and timber sales. Those taxes include property taxes such as productivity and yield taxes, death taxes, individual income, and corporate income taxes. Many tax experts are not satisfied with these taxing systems, particularly corporate and individual income taxes. Some feel direct tax systems with progressive structures distort market decisions while not yielding enough revenue to balance the budget at lower tax rates (higher tax rates magnify the inequities of any tax). One indirect tax system which has been considered several times for use nationally, but has never been imposed, is a value added tax (VAT) system. This system has recently been adopted by the European Economic Community (EEC), in several other countries, and in the state of Michigan (First Directive 1967 and Michigan 1975).

The tax on value added is levied at each stage of the production and distribution cycle, based on the increase in value of a product or service as it is bought and sold. For the tax to remain neutral in terms of market decisions, it

should be imposed at a flat rate in the same manner as a sales tax, however, every sale in the chain is charged the tax (instead of only retail sales). The government charges producers the tax at each level, so the producer will collect the VAT from the buyer at the time of sale. The producer then deducts any VAT he was charged when he purchased the taxable inputs necessary to make the product. The balance is paid to the government. The effect is to impose the tax at each stage of production on the sum of wages, interest, rents, profits, and other factors not received as taxable inputs--hence, a tax on value added.

A study of value added taxation is especially timely now as the national deficit increases. Politicians and economists are beginning to suggest new ways of balancing the budget. Several times in our nation's political history the VAT system has been suggested, most recently with the Tax Restructuring Act of 1979. It has always sparked controversy, and has never been implemented.

Other examples of current interest include a suggestion by Lester Thurow (1981), Professor of Economics at MIT, for use of the VAT to reform the social security system. The most recent doctoral disertation concerning the VAT, completed in 1982 (Rebhun), attempts to establish the political climate in which <u>new</u> taxes were adopted by

Congress in the past. The results are used to predict when a VAT might be passed by Congress. Acceptance of the VAT is found to depend on political necessity (i.e. a major fiscal crisis, or the implementation of a new social program). According to this study, timing is the main standard for implementation not VAT's compliance with the criteria for a good tax. Finally, Martin Feldstein, chairman of the Council of Economic Advisers, supports the VAT system while the Reagan administration remains ambivalent (Hoertel 1983).

Meanwhile, a national study group found that among 25 forest economic research problems, the following ranked as third in importance:

> Develop recommendations for more equitable systems of taxation ... for forest lands (USDA 1978).

Also, a task force of the above study group recommended that a major goal for forest economics research by the U.S. Department of Agriculture and universities should be to

> determine the effects of public policies on the production of timber from public and private lands (USDA 1978).

Furthermore, A. L. Kingshott, treasurer of Ford Motor Company, Ltd., stated

> it is only by considering specific effects of VAT on individual industries that it will be possible to build a constructive body of knowledge about what will be the full implications of whatever system or whatever rates may be imposed in due course (Kingshott 1969).

Objectives

The overall objective of this study is to examine the probable short-run impacts upon private forest management in the southeastern United States if a value added tax were to be imposed. Emphasis is on determining directional rather than absolute impacts on equilibrium price and quantity in the stumpage market by tracing hypothetical VAT-impacts on a major wood-using consumer good: new residential housing.

More specific sub-objectives are:

1. To conduct a thorough literature review determining (a) how forestry and forest products are treated by the VAT, and how it might be levied on forestry in the United States; (b) what the administrative burdens of the tax are in terms of cash flow and bookkeeping; and finally, (c) what the economic effects are in terms of neutrality, equity, shifting, incidence (who pays), and prices.
2. To determine the possible short-run effects of VAT-induced changes in new housing prices on prices and quantities of southern pine sawtimber stumpage sold.
3. To estimate the sensitivity of these predicted impacts to the level of the VAT.

Approach

Following a literature review into several aspects of the VAT, an econometric model is developed to examine the supply and demand of southern pine sawtimber stumpage and new single-family housing. In this section, the data base is described, the model is specified and finally, the estimation procedures used in the analysis are described. Supply and demand functions in both the stumpage and housing sector are empirically derived.

Short-run impact elasticities of the price of houses sold are determined for the quantity of houses sold plus the price and quantity of stumpage sold. From this, the impact of a housing price change caused by the imposition of the VAT is determined. Further, simulations with different value added tax rates are performed. Finally, the results are reviewed, implications of the tax are summarized and conclusions are drawn.

LITERATURE REVIEW

History

The concept of a value added tax was originated by von Siemons, a German economist in 1918 to replace the newly established turnover tax. The turnover or cascade tax is a tax charged every time the materials or products change hands. The tax is charged on the full value of the product, including taxes previously paid. Including prior taxes in the tax base causes a cascade effect, which results in a difference in effective tax rates depending on the extent of vertical integration in an industry or firm. Consequently, the tax content cannot be accurately measured in final product price. This caused problems in international trade since the General Agreement on Tariffs and Trade (GATT) allowed indirect tax rebates at borders, while the amount of tax on a particular product at the border was uncertain. However, the turnover tax gained widespread popularity so that no tax on value added was imposed until 1954. At that time, France adopted a limited form of the VAT, primarily applicable to transactions by manufacturers and wholesalers (Smith et al., 1973).

The VAT was proposed in the United States as early as 1921, then again in 1941, and in 1979. In the meantime, the Brookings Institution recommended a value added tax for use in the states of Alabama and Iowa. Finally, Michigan was the first to adopt a modified form of the VAT in 1953; however it was repealed in 1967 (ACIR 1978).

The turning point for VAT legislation was in 1967 when the European Economic Community (EEC), on the recommendations of the Neumark Commission, a working group investigating the harmonization of tax systems in the community, issued a directive obliging all EEC members to adopt a VAT. This directive outlined the general character of the VAT, but let rates and the details of the tax be determined by each country with its own political and economic problems (First Directive 1967 and Second Directive 1967). Since then many European countries have adopted the taxing system, as well as some Scandanavian countries.

The United States continued to be interested in the VAT, funding several studies of the tax. In 1972, President Nixon asked an Advisory Commission on Intergovernment Relations to study the VAT as a means of raising revenue to help finance local schools and thereby reduce local property taxes (ACIR 1972). This task force recommended against the adoption of VAT as a substitute, in whole or in part, for

federal income taxes and/or payroll taxes. However, they advised that the United States consider VAT again when the need for substantial additional revenues arose, rather than increasing corporate or personal income taxes (Price Waterhouse 1979).

Michigan adopted its current modified form of a value added tax, the Single Business tax, in 1975. It differs substantially from the traditional European VAT. (Michigan 1975).

As the United States' federal deficit grew, interest in the value added tax system was again stimulated. In 1979, Representative Ullman, Chairman of the House Ways and Means Committee, introduced the Tax Restructuring Act for adopting a VAT. Later, Senate Finance Committee Chairman, Russell B. Long, drafted similar legislation proposing a VAT as a partial replacement for social security taxes and for reductions in corporate and individual income tax rates (Price Waterhouse 1979). These proposals failed to result in any legislation, but the federal deficit continues to grow, keeping interest in a value added tax system alive.

Description of Tax

Types of VAT

There are three major types of VAT differing in their provision for recovery of capital expenditure (Price Waterhouse 1979). First, the national income type requires VAT paid on capital goods to be amortized over a period of years in a manner similar to depreciation. Its tax base approximates the net national income. This type demands detailed record keeping. Like an income tax, the income type VAT requires an excess of year-end inventory to be deducted (Shoup 1969a). Argentina is one country currently using this type of VAT.

The second type is the gross national product type where the tax base approximates GNP in the private sector. It allows no recovery of the tax paid on capital investment (Price Waterhouse 1979). Shoup (1969a) believes this tax puts heavy pressure on firms to use methods of production which do not require capital assets and do not involve frequent year-to-year fluctuations in physical volume of inventories. The GNP type is used in several South American countries.

Finally, the consumption type of VAT allows a firm to recover the full amount of VAT paid on capital goods at the time of investment. Of the three types, the consumption

type is the most favorable to capital formation since it results in an equal tax on profits derived from labor and capital. It is used by most countries now imposing a VAT. Since it is the most favorable to capital gains, the consumption type is most likely to be adopted in the United States where there is concern over the pattern of decreased savings and investment (Price Waterhouse 1979).

Methods of Calculation

Most of the literature lists three methods for calculating the VAT base: 1) the addition method, 2) the subtraction method, and 3) the invoice method. However, Smith et al. (1973) do not differentiate between the subtraction method and the invoice method. They assert that the invoice method is a way of applying the subtraction method.

Specifically, the addition method is one which involves summing all wages salaries, interest, profits, rents, and royalties, then applying the tax rate to this amount (GAO 1980). A Price Waterhouse study (1979) on the consumption type VAT, states that this base would have to be modified for capital purchases. Also, Kingshott and others believe this calculation procedure creates doubts as to whether the VAT is a direct or indirect tax. Another criticism of the

addition method by Kingshott (1969) and Smith et al. (1973) is the problem arising when differential rates are used. There may be a wide discrepancy between the rate of taxation intended and that actually levied on the individual product. This occurs when materials are bought from a third party whose products are subject to different rates of tax. Kingshott believes this phenomena can lead to sub-optimum integration of businesses. Tait (1972) criticizes this calculation method on the basis that it is only sensible on an annual basis.

On the other hand, Kingshott (1969) recommends the addition method when substituting VAT for corporate or individual income tax, and Tait concedes that it has less inflationary impact than other methods. Ture (McLure and Ture 1972) endorses the addition method contending that virtually all the information required to compute the tax is included on the present income tax forms and supporting documents. He further states that this method of VAT computation involves less work for the taxpayer than the present income tax.

With the subtraction method, the VAT rate is applied to gross receipts minus all payments made by a firm to suppliers of materials and services. This method differs from the invoice method in that the subtraction tax is

calculated on the difference between aggregate purchases and sales for an entire period, while under the invoice method the tax is calculated separately on each sale (Price Waterhouse 1979). Ture (McLure and Ture 1972), however, contends that the subtraction method needs little further information to compute the tax, therefore causing less administrative burden. This method is applied in the Michigan Single Business tax which is the only experience to date in the United States with a VAT-type tax.

Finally, the invoice or credit method applies the VAT rate to the amount of each sale and shows the tax as a separate item on the sales invoice. To compute the taxes paid to the government, a firm adds up all the VAT charged to customers, and subtracts all the VAT paid to suppliers, the remainder is the VAT liability, as illustrated in Table 1.

Thus, as VAT is intended, the tax is passed forward in prices until the consumer pays the entire amount. Ture (1973), however, contends that this passing forward is by no means clear. Some argue that this method, used in all European countries, has as its principal advantage a self-enforcing mechanism because of the invoices passed within the producing chain (GAO 1980, GAO 1981, Carlson 1980, Smith et al. 1973). If one firm did not report all its sales,

TABLE 1

Invoice Method Calculation

	Purchasing price w/VAT (dollars)	Sales price w/out VAT (dollars)	10% VAT (dollars)	Tax paid to govt. (dollars)
Producer 1	0	100	10	10
Producer 2	110	150	15	5
Wholesaler	165	200	20	5
Retailer	220	250	25	5
Final Consumer	275	-	-	-
				25

Total value added = $250.

Total VAT collected = $25.

Source: GAO 1981.

the government would notice the omission from the returns of other firms.

Rate of Taxation

In Table 1, the VAT is charged at 10% throughout the production chain. However, a flat rate VAT, is rarely universally applied. Because of historical taxation patterns, social, political, and economic forces, meshing the VAT with other forms of taxation, and administrative factors, adjustments to a single rate universally applied VAT system are usually made (Smith et al. 1973). Common adjustments include specific exemptions from the tax, multiple rates applied to different categories of goods, and a reduced tax base on certain goods.

Exemptions are generally based on classes of products, classes of services, and/or classes of taxpayers and include zero rating and normal exemptions (Smith et al. 1973). Zero rated goods are exempt from VAT when sold. Producers are entitled to refunds on any VAT paid on purchases made producing the zero rated product. Normal exempt goods have no VAT levied on their sale, but the seller cannot claim a refund for VAT paid on purchases. Therefore, it becomes part of the seller's costs and will be reflected in his prices. These exemptions are often granted to enterprises

such as banking and small businesses, where administration of the VAT is prohibitive.

According to Smith et al. (1973), multiple rates are used primarily to lighten the tax burden on necessities. The typical rate format consists of a standard rate for most goods and services, and a reduced rate for specified items regarded as necessities. In some countries an increased rate is applied on so-called luxury items. This specification is justified on the basis of making the tax less regressive; however, it greatly complicates administration, especially when using the addition or the subtraction methods.

The reduced tax base allows for special consideration for a product without resorting to explicit multiple rates. Under this method, the tax rate is imposed on less than 100 percent of the product's value. Its purpose is to make the tax more equitable. This method is used in Sweden (Smith et al. 1973)

The first round effects of multiple rates and exemptions on price changes are compared in Table 2. Note that unless the reduced rate is in the final stage, it will have no effect on the price. If a product is exempt at any stage other than the final, the tax will cascade like the turnover tax. However, if the reduced rate or the exempt rate is at

TABLE 2

Tax and Price Effects of Multiple Rates and Exemption

	Scenario 1 All Transactions at 10% Selling Price (dollars)		Tax Due (dollars)
1. Forest Owner			
Sells for		1000	
VAT	(10)	100	
Total S.P.		1100	100
2. Pulp Mill			
Buys goods at 1100			
incl. tax, sells for		1500	
VAT	(10)	150	
Total S.P.		1650	
Credit	(10)	100	50
3. Paper Mill			
Buys goods at 1650			
incl. tax, sells for		2200	
VAT	(10)	220	
Total S.P.		2420	
Credit	(10)	150	70
4. Printer			
Buys goods at 2420			
incl. tax, sells for		2500	
VAT	(10)	250	
Total S.P.		2750	
Credit	(10)	220	30
5. Book Retailer			
Buys goods at 2750			
incl. tax, sells for		3000	
VAT	(10)	300	
Total S.P.		3300	
Credit	(10)	250	50
6. Total tax collected by Government			300

TABLE 2

Tax and Price Effects of Multiple Rates and Exemption (cont.)

	Scenario 2 Stage 2 at 5%		
	Selling Price (dollars)		Tax Due (dollars)
1. Forest Owner			
Sells for		1000	
VAT	(10)	100	
Total S.P.		1100	100
2. Pulp Mill			
Buys goods at 1100			
incl. tax, sells for		1500	
VAT	(5)	75	
Total S.P.		1575	Net
Credit	(10)	100	Credit (25)
3. Paper Mill			
Buys goods at 1650			
incl. tax, sells for		2200	
VAT	(10)	220	
Total S.P.		2420	
Credit	(5)	75	145
4. Printer			
Buys goods at 2420			
incl. tax, sells for		2500	
VAT	(10)	250	
Total S.P.		2750	
Credit	(10)	220	30
5. Book Retailer			
Buys goods at 2750			
incl. tax, sells for		3000	
VAT	(10)	300	
Total S.P.		3300	
Credit	(10)	250	50
6. Total tax collected by Government			300

TABLE 2

Tax and Price Effects of Multiple Rates and Exemption (cont.)

	Scenario 3 Stage 3 at 5% and Final Stage Exempt Selling Price (dollars)		Tax Due (dollars)
1. Forest Owner			
Sells for		1000	
VAT	(10)	100	
Total S.P.		1100	100
2. Pulp Mill			
Buys goods at 1100			
incl. tax, sells for		1500	
VAT	(5)	75	
Total S.P.		1575	Net
Credit	(10)	100	Credit (25)
3. Paper Mill			
Buys goods at 1575			
incl. tax, sells for		2200	
VAT	(10)	220	
Total S.P.		2420	
Credit	(5)	75	145
4. Printer			
Buys goods at 2420			
incl. tax, sells for		2500	
VAT	(10)	250	
Total S.P.		2750	
Credit	(10)	220	30
5. Book Retailer			
Buys goods at 2750			
incl. tax, sells for		3000	
VAT	"E"	0	
Total S.P.		3000	
Credit		0	0
6. Total tax collected by Government			250

TABLE 2

Tax and Price Effects of Multiple Rates and Exemption (cont.)

	Scenario 4 Stage 3 at 5% and Stage 4 Exempt Selling Price (dollars)		Tax Due (dollars)
1. Forest Owner			
Sells for		1000	
VAT	(10)	100	
Total S.P.		1100	100
2. Pulp Mill			
Buys goods at 1100			
incl. tax, sells for		1500	
VAT	(5)	75	
Total S.P.		1575	Net
Credit	(10)	100	Credit (25)
3. Paper Mill			
Buys goods at 1575			
incl. tax, sells for		2200	
VAT	(10)	220	
Total S.P.		2420	
Credit	(5)	75	145
4. Printer			
Buys goods at 2420			
incl. tax, sells for		2500	
VAT	"E"	0	
Total S.P.		2500	
Credit		0	0
5. Book Retailer			
Buys goods at 2500			
incl. tax, sells for		3000	
VAT	(10)	300	
Total S.P.		3300	
Credit		0	0
6. Total tax collected by Government			520

TABLE 2

Tax and Price Effects of Multiple Rates and Exemption (cont.)

	Scenario 5 Final Stage at 5% Selling Price (dollars)		Tax Due (dollars)
1. Forest Owner			
Sells for		1000	
VAT	(10)	100	
Total S.P.		1100	100
2. Pulp Mill			
Buys goods at 1100			
incl. tax, sells for		1500	
VAT	(10)	150	
Total S.P.		1650	
Credit	(10)	100	50
3. Paper Mill			
Buys goods at 1575			
incl. tax, sells for		2200	
VAT	(10)	220	
Total S.P.		2420	
Credit	(10)	150	70
4. Printer			
Buys goods at 2420			
incl. tax, sells for		2500	
VAT	(10)	250	
Total S.P.		2750	
Credit	(10)	220	30
5. Book Retailer			
Buys goods at 2750			
incl. tax, sells for		3000	
VAT	(5)	150	
Total S.P.		3150	Net
Credit		250	Credit (100)
6. Total tax collected by Government			150

Source: adapted from Schiff 1974.
Number shown in () are tax rates.
"E" Exempt taxpayers. Collects no tax and not entitled to credit.
"S.P." Selling Price.

the final stage, then prices and taxes paid will be less than for standard rated goods.

Administrative Burden and Cash Flow of the Firm

The administrative burden of a value added tax to the firm is measured by the compliance cost (expenditure necessary for bookkeeping and payment of the tax). Smith et al. (1973) enumerate several variables affecting compliance costs to firms. One variable is whether the company is retail, wholesale, or otherwise. A wholesale firm is likely to have only one product type, whereas retailers are likely to have a variety of products which may be taxed at different rates.

The size and sophistication of the company is also an important variable of compliance cost. The larger the company, the lower the compliance cost as a percentage of the VAT. In fact, larger computerized firms in Germany found their extra expenses to be nil, while smaller businesses estimated their tax compliance costs had risen by 22% (Tait 1972). Very small businesses are usually exempt and moderately sized firms are often given special accounting privileges and extended payment schedules due to the bookkeeping burdens and cash flow problems imposed by a VAT.

The rate at which the tax is imposed, and the number of rates and exemptions used will also affect administrative burden. Compliance costs, as a percentage of total tax collection, are lower as the rates increase. If the VAT were substituted, at least partially, for a tax which was administratively more complex, then the burden would be lightened. At the same time, multiple rates and exemptions complicate the VAT. Each rate used for each item must be specified on all records of the commodity. Furthermore, zero rating is easier to administer than exemptions because exempt goods require additional bookkeeping for the taxpayer as well as creating more auditing problems for the tax collectors (GAO 1981). The compliance cost may vary between the income, GNP, and consumption type VAT.

The invoice format can also affect compliance costs. Ireland representatives, after imposition of the tax, claimed the need for standardized invoices listing the VAT rate separately to allow for more accurate and efficient compliance with the VAT (GAO 1980).

Finally, remittance procedures and accounting period affect compliance costs. GAO (1980) reported that firms in most EEC countries noted reduced business cash balances. Cash flows can vary, depending on whether the company must pay VAT due on sales before or after it receives full

payment from customers. If they must pay before, then there is net cash outflow. If they pay after cash is received, then there is a net cash inflow. In the United Kingdom and some other countries, the taxpayer need not include credit sales in the tax statement until he receives the actual cash. However, many countries still require the VAT to be paid to the government during the tax period when the invoice is issued, rather than when payment for the purchase is received. This requirement puts an extra burden on firms with a large proportion of credit sales.

The characteristics of individual firms also affect cash flows. The higher the percentage of credit sales for a company, the greater the cash outflow due to VAT. Similarly, the longer the payment terms of a company's accounts receivable, the greater the cash outflow, i.e. the smaller the firm's cash balance. Conversely, the longer the payment terms of a company's suppliers, the greater the cash inflow from VAT on purchases and the greater the firm's cash balance. Cash flow can be affected by the company's gross margin (value added). Likewise, growing sales affect a company's situation where growing cash collections increase cash balance, while increasing credit sales may decrease cash collections. Fimally, firms with seasonal sales will have the same cumulative VAT cash outflow as an equivalent

company with level sales; however the company's seasonal cash flow will fluctuate.

Smith et al. (1973) found that EEC countries reported a 0.2 - 3.8% VAT-induced decrease in operating profits. Furthermore, he found that businessmen in Europe have not found compliance with the VAT unduly burdensome once the transition period was over. Carlson (1980) reports the same, although VAT necessitates more detailed record keeping than the taxes it replaced. In every EEC country, business representatives reported that start-up costs for the VAT were considerable, even for large corporations. Added employees were needed to analyze the corporate activities and determine whether or not activities were taxable, then to adjust their accounting systems accordingly.

In conclusion, Tait (1972) contends that the statistical information gained can be used for input/output forecasts which could provide a comprehensive profile of the structure of the economy. This information yields a valuable statistical and technological framework useful for public and private management decision making, as well as marketing strategy.

VAT in Europe

The value added tax has been widely used since the early 70s when the European Economic Community (EEC) issued a directive requiring all its members to adopt the VAT. The tax structure was generally defined, but individual ordinances were left to each country. Treatment of forestry by a national VAT in the United States is likely to follow that of other countries, as outlined in Table 3.

Many of the reduced rates impact upon forest products. Frequently, reduced rates apply to books and most printed matter, fuel wood and kindling, woodwaste including sawdust, rough wood and roughly squared wood, and poles and stakes. Other products often having reduced rates, used in the production of stumpage include seeds, seedlings, and fertilizers. In Belgium (van Waardenburg 1980), standing timber itself has a reduced rate along with the activities concerning cultivation and harvest. The Federal Republic of Germany (Huiskamp 1980a), reduces rates on all materials for construction, including concrete and steel, as well as lumber and plywood. In the Netherlands (Huiskamp 1980b), several intermediate processes for wood products have reduced rates, including storage, drying, cooling, and disinfection. Also, services to foresters such as bookkeeping and tax consultants are taxed at a reduced rate.

TABLE 3

Illustrations of European VAT by Country

Country	EEC member	Tax Replaced	Rates Reduced[a]	Normal[b]	Luxury[c]
			(percent)		
Austria		Turnover tax	8	18	30
Belgium	+	Turnover tax	6[d]	16	25
Denmark	+ *	Single-stage wholesale tax		20.25	
France	+	Manufactures' sales and turnover taxes	7[e]	17.6	33.3
FDR	+	Turnover tax	6.5[f]	13	
Ireland	+ *	Turnover and wholesale taxes	10	20	g
Italy	+	Turnover and municipal consumption taxes	6[h]	14	35[h]
Luxembourg		Turnover tax	5[i]	10	
Netherlands	+	Turnover tax	4	18	
Norway		Single-stage retail sales tax		20	
Sweden		Turnover tax		20.63[j]	
United Kingdom	+ *	Payroll tax on service industries and single-stage wholesale taxes		15	

\+ Symbol + denotes presence of treatment.
\+ * Imposed tax upon entry into EEC.
[a] Reduced rate is lower than normal rate imposed on necessity items.
[b] Normal rate is the VAT rate imposed on most goods and services.
[c] Luxury rate is a higher than normal rate imposed on goods and services considered extravagant.

TABLE 3

Illustrations of European VAT by Country (cont.)

Country	Forest Products Reduced	Special Treatment
Austria	+	+
Belgium	+	
Denmark		
France	+	
FDR	+	+
Ireland	+	+
Italy	+	+
Luxembourg	+	+
Netherlands	+	+
Norway	+	+
Sweden	+	+
United Kingdom	+	

Source: Synthesized from Aaron 1981, Butzelaar 1980, Carlson 1980, Corello 1980, deBrau-Haz 1980, Dik 1980, Huiskamp 1980a, Huiskamp 1980b, Mittendorff 1980, Scholten 1980, Spang-Thomsen and Bratholm 1980, Spitz 1980, Thomas 1980, and van Waardenburg 1980.

[d]Rate of 2% for delivery of wood.

[e]Newspapers are subject to a reduced tax base of 30%, so the actual rate is 2.1%.

[f]The turnover of agricultural and forestry business is taxed at special rates for 5 to 13%.

[g]Luxury rates have been abolished, and certain luxury items are taxed at the reduced rate, then are subject to excise taxes. Livestock and property in Ireland are subject to reduced tax bases, and their effective rates are 1 and 3% respectively.

[h]Also special rates for beef taxation, and non-luxury hotels.

[i]A special 2% rate applies to certain dairy products, meats, pharmaceutical products, and tobacco products.

[j]Uses variable tax base to adjust rates.

As noted earlier (see Table 2), reduced tax rates in intermediate market stages do not effect the price of the good, although it may affect cash flow or administrative costs. Some of these reduced rates do apply to consumer products, and therefore may raise prices less than for substitute goods.

Several European countries legislated special treatment for agricultural operations including forestry (Council of the EEC 1968). In fact the EEC proposed a flat rate global credit offset, and a common low tax rate, now used in several countries. The credit offset is the tax rate applied to the farmer's or the timber grower's output price to estimate the VAT content on his purchases of raw material. The common low tax rate is usually imposed as half the normal tax rate for agricultural products. These provisions allow the forest land owner the freedom of not having to keep invoices for purchases, or be involved in payments to the government at all, since theoretically the amount of the credit offset equals the amount of tax charged.

As described by Tait (1972), the forest output purchaser is liable for the timber grower's VAT, and for the VAT on his own value added. The process is as follows: in the first stage the farmer/timber grower pays the normal VAT

rate (20% in this case) on his raw material. He then sells his product at a price which includes the VAT paid on his inputs (just as any exempt party). The producer buys the farmer/timber grower's output then computes his immediate liability by subtracting the global offset rate (in this example 5%, which in practice is estimated to equal the amount of the tax the farmer/timber grower paid when buying his raw materials) from the reduced rate of the tax on agricultural products (10%), and multiplies the difference (5%) by the farmer/timber grower's selling price (see Table 4).

The purchasers's theoretical liability is what the farmer/timber grower owed the government. However, the purchaser does not actually pay this sum to the government, but subtracts it from his final tax liability for his own reduced rate sales. The purchaser is the only one who has any dealings with the government. On the other hand, the timber grower can still elect to be treated as a regular taxpayer, if his liability to his suppliers is more than the credit rate.

Another special treatment used in several countries is the exemption of rent on unimproved land which may have its effect on land lease agreements for nonindustrial private forests. Also, in many countries, including the United

TABLE 4

Computations to Assess Agricultural VAT Liability

		Price without tax (dollars)	Tax (dollars)	Price with tax (dollars)
Farmer				
	Inputs	75	15 (20%)	
	Value added	210		210
	Output	285	15	300*
Purchaser				
	Inputs	285	15 (10-5%)	300
	Value added	115	25	140
	Output	400	40 (10%)	440

Source: Tait 1972.
*This is the only figure known to the farmer/timber grower.
**Numbers shown in ( ) are tax rates.

Kingdom, printed paper products, such as books, magazines, and so forth, are zero rated, as well as construction of buildings and the supply of building materials.

VAT in Michigan

The Michigan Single Business Tax (Michigan 1975) is the only value-added type tax currently in effect in the United States. The Act (1975) describes the tax as one on "the privilege of doing business, and not upon income". Price Waterhouse (1979) describes its calculation as the subtraction method, however, the calculation has great similarities to the additive method (ACIR 1978). The tax base is calculated by adding federal taxable income, plus compensation paid (wages), interest paid, and depreciation (because it is deducted from the federal taxable income, so it must be added to avoid double deduction for capital investment). Subtracted from this sum is interest received, dividends received, capital purchases, and various exclusions and deductions. The result is the value added tax base against which a 2.35% across the board tax rate is levied. The tax is paid on quarterly installments with a required annual return.

The only special treatment used in Michigan is exemptions and some special deductions. According to a Single Business

Tax (SBT) bulletin (Michigan 1978), those businesses which are exempt by federal standards are exempt from the Michigan SBT. One example is the portion of the tax base attributable to the production of "agricultural goods". Agricultural goods, by Internal Revenue Service definition, include nurseries and Christmas tree farms; however, forestry operations (businesses) are taxable. On the other hand, the private landowner of a small woodlot making and occasional sale of timber is exempt because it is not seen as engaging in business activity, but as a sale of capital assets. As noted before, the addition method creates some doubts as to whether the VAT is a direct or indirect tax, and therefore some doubts as to whether it is completely passed forward.

Tax Restructuring Act

The Tax Restructuring Act of 1979 is an example of how a federal value added tax might be imposed in the United States. A standard rate of 10 percent was proposed for most goods and services. A reduced rate of 5 percent applied to retail sales of food and nonalchoholic beverages, the sale and rental of residential real property for use as principle residence, medical care, and prescription drugs. Zero rated

items included exports, nonretail sales by farmers and fishermen, mass transit, activities of charitable organizations, educational activities of government, and interest. Small businesses with sales below $10,000 could elect to be exempt from the VAT.

The Act (Price Waterhouse 1980), although not passed, proposed the consumption type VAT with an invoice method of calculating the tax base. A business would have made monthly deposits, and filed returns on a quarterly basis. Refunds would have been made upon filing a quarterly return showing a VAT over payment.

The cuts in other taxes proposed to offset the VAT were specified as:

1. Social Security taxes cut by 2.15% for both employers and employees.
2. Individual income tax brackets would have been widened and rates reduced. In addition, the bill would have provided incentives for savings in the form of a tax deferred savings plan and a dividend reinvestment plan.
3. Reduced corporate income tax rates would apply to the first $160,000 of taxable income. Depreciation allowances would have been liberalized and more generous investment tax credit offered.

Economic Effects

Neutrality

GAO (1981) defines a tax as neutral if it does not change the relative prices of economic goods. According to Smith et al. (1973), the VAT is neutral with respect to consumer choices. The exemptions mentioned earlier may skew the VAT's neutrality, but not substantially since substitutes usually have the same rate, and because of the VAT's wide scope. However, Smith et al. (1973) contend that VAT could cause product switching in the long run. First, consumers faced with reduced buying power because of the tax might economize by switching to cheaper products. Also, if the VAT triggered wage increases, this would eventually lead to differential price increases resulting in some products being more expensive than competing products. However, from a business point of view, Smith et al. (1973) claim the VAT is neutral. It minimizes tax factors in business decisions since it falls equally on all businesses regardless of their type of organization, efficiency, capital or labor intensity, and use of equity and debt financing. They are discussing the consumption type VAT alone, ignoring any biases produced by the GNP or national income type VAT.

The Price Waterhouse study (1979) reports neutrality in terms of consumption versus savings. Proponents claim that

high rates of individual income tax will discourage savings. Whereas, since the VAT is a tax on consumption, it is seen as creating an incentive toward savings and investment. Furthermore, VAT-induced reduction in demand could keep prices from rising the full amount of the VAT and could thus reduce the possible inflationary impact of the VAT.

Price Waterhouse (1979) reports that the VAT eliminates the bias of the income tax in favor of labor intensive industries. This bias is said to stem from the fact that labor costs are deducted currently, while capital investment must be amortized. This bias is mitigated with the consumption type VAT, where the tax paid on capital goods is credited in the period of purchase. Therefore, since no VAT is paid on capital or labor, it is neutral between these factors.

Since, VAT is imposed on all transactions, regardless of profitability, it is neutral with respect to degrees of production efficiency and debt financing (Price Waterhouse 1979).

Regressivity

Regressivity is one of the main arguments against VAT. Price Waterhouse (1979) argues that by increasing the price of goods, the impact of VAT will fall most heavily on those

who spend the greatest percentage of their incomes on necessity items. Dalamagas (1978), when writing about the possibilities of VAT in Greece, contends that this is not a basis for abandoning such a tax. He claims that a balance can be restored through more progressive direct personal taxation. Reckers & Bates (1980) claim the regressive nature of the tax can be diminished by applying lower rates for necessities and by allowing credit on individual tax returns.

Incidence

According to Seligman (1959), incidence is the burden of a tax on the ultimate taxpayer. The impact of the tax is the immediate result of the original imposition of the tax, or who pays in the first instance. The process of transferring the tax from the first tax payer to the ultimate payer is called shifting.

Garner (1977) claims that if the firm's objective is to maximize profits, then the tax will necessarily be shifted. It can be shifted forward to the consumer, in the form of higher prices, or backward to the factors of production in the form of lower factor prices. However, Garner (1977) ignores the possibility that the tax may be absorbed by cutting costs through higher efficiency, or through lower

returns to capital. Garner further claims that the extent of the shift depends not only on the maximization objective of the firm, but also on the market structure, price elasticities of final demand, price elasticities of final supply, technology, and degree of specialization.

GAO (1980) reports that the VAT is intended to be shifted forward at each stage of production so that the buyer is always paying the full tax, then credited for it until it settles on the final consumer. The effect of a consumption tax is to produce a constant difference between price paid by the buyer and the price received by the seller. Both buyers and sellers suffer losses beyond the taxes they pay. However, Jenkin (1959) claims the price elasticity of demand and supply govern the incidence of consumption taxes. If a seller continues to produce at the same rate allowing buyers to set the price, a perfectly elastic supply curve, then the whole tax will fall on the seller to the extent that total revenue is reduced and an inventory surplus exists. If the buyer buys at the same rate after the tax is imposed, the whole tax falls on him, in a perfectly elastic demand system. For this reason, the seller will cut back on production until he can maximize profits, or marginal benefits equal marginal costs.

Price Effects

The price effects reported in the European section were usually in response to the substitution of VAT for some other indirect tax. However, in the United States, the VAT would either be substituted for a direct tax (individual and corporate income, or social security) or it would simply be added to the existing tax structure.

Garner (1977) claims the price effects will depend on the incidence of the VAT as well as the tax for which it is being substituted. If a VAT replaced corporate income taxes, he projects insignificant price effects, assuming both taxes produce the same yield and both are shifted to the consumer. If neither of the taxes are shifted forward (which most literature suggests is highly unlikely), then prices should remain unchanged but wages would decline. Note that Garner is not discussing the invoice method of consumption type value added tax, but is speaking of all three types of tax with any method of calculation. Where the VAT is passed forward, but the corporate income tax is not, he says prices net of the tax could be reduced by the amount of the income tax if businesses were content with the same net profit. Since it is unlikely businesses will reduce prices, larger profits and higher prices to the consumer will result. Finally, if the corporate income tax

is passed forward, but the VAT is not, prices could also fall. In fact Garner distinguishes between the size of the firm and whether or not prices would be increased by the value added tax. He also suggests that there is a psychological tendency for sellers to increase prices by more than a newly imposed VAT.

Smith et al. (1973) contend that although general price increases are probable, individual product prices depend on elasticity of demand for all other purchases by "families" whose freely available funds for general use have been decreased. He further claims the impact of VAT on prices can be minimized by four steps: 1) introduce VAT during a period of relatively stable wage and price conditions, 2) introduce it as a direct revenue replacement for another tax, rather than as a supplementary source of revenue, 3) include only entities and categories previously taxed, and 4) provide for cooperation between business and government to minimize unwarranted price increases (i.e., increases above the rate at which the tax has been imposed).

Carlson (1980) and some others believe the inflationary impact of the VAT would primarily be a "one-shot" increase in the price level. He concedes, however, that the effects may be intensified as wage contracts, social security payments, and other indexed items are adjusted.

Empirical Studies on the Impacts of the VAT

Very little empirical work focusing on the impacts of the VAT exists in the literature. However, what was found ranged from papers noting price changes after actual imposition of the tax to complex input-output studies predicting price changes before the tax was imposed.

GAO (1980) noted the price changes in seven European countries and the possible causes. According to this study, price increases in the United Kingdom and West Germany were negligible. Belgium had only a 1 percent increase in prices which was attributed to less-than-expected price decreases resulting from the abolition of the cascade tax. Ireland, Italy, and the Netherlands each had 2 percent VAT-induced increases in prices. All three countries observed problems with double taxation where some businesses charged the VAT plus some prior tax on the sale of goods. In addition, Italy and the Netherlands found that abolishing the cascade tax did not result in expected price decreases. Finally, the imposition of the tax in Denmark resulted in approximately a 10 percent increase in prices. This was a result of double taxation and the fact that the tax was designed to increase tax revenues.

Similarly, Tait (1981) evaluated 31 countries using data on the consumer price index (CPI) in each country. After

initial examination, six countries were found to have a one-time increase in prices with the previous inflation continuing after the imposition of VAT. The VAT was found to increase the CPI rate of change in ten countries (i.e. accelerate inflation). Both effects were noted in two countries, Honduras and Norway. No effects on the CPI were noted in 13 countries. Tait re-examined the causes for changes in CPI and reported that VAT caused CPI to shift upward in only five out of the original six countries. He also found that the increased rate of change in CPI appeared in only three out of ten countries, and this was associated in each case with expansionary wage and credit policies. Only Norway was determined to experience both effects, and no effects were determined in 21 countries. Tait concluded that it is possible, if not the norm, to expect equal-yield VAT substitution to have no effect on the rate of change in prices. Additionally, even if an increased yield is derived and prices increase, it will not necessarily accelerate inflation.

Woods (1974) also used the CPI to measure changes in price after the imposition of the VAT. He listed the CPI one and two quarters and one month before the imposition of the tax, then six months after. He then listed the percent change between one month before and six months after the

tax. In all cases, the change in price was less than the VAT rate. However, in most countries the VAT replaced some other tax. If imposed in the United States, it is not known whether the VAT would be substituted for another tax or merely added to present taxes.

On the more complex side, Norman (1981) cited two econometric studies done in Sweden on price effects of VAT. One (Hansson 1980) estimated a price equation in which the quarterly percentage change in prices (CPI) was a function of three seasonal dummy variables, the rate of change of the VAT, capacity utilization, the rate of change of labor costs in nominal terms, the average rate of change in real labor costs in the two preceding quarters, and expected inflation determined by inflation rates in ten preceding quarters. The equation was estimated for the period from 1958 through 1976. An Almon lag structure for a dynamic system was used. The coefficient on the VAT variable ranged for .90 to 1.02 in five separate equations. These findings indicated an increase in VAT would be fully translated into higher prices within one quarter.

Norman also noted a study by the Economic Research Unit at the Economic Research Institute of the Stockholm school of Economics. In this study, simulations were performed on a multi-equation econometric model designed to capture

market interactions, the business cycle, and other policy measures for the entire Swedish economy. The results suggested that an increase in the VAT in 1971 from 15 to 20 percent would have caused an increase in the CPI of approximately 2.5 percent after two years. That means a 2.5 percent increase over what prices would have been if taxes had not been raised and all other policies remained the same.

To estimate price effects of a VAT imposition, Aaron (1968) carried out an input-output analysis. He concentrated on the complete substitution of the VAT for corporate income taxes. He examined the price effects in several industries, compared the tax liabilities in these major industries, and estimated the size of adjustments in factor payments. Aaron modeled the GNP type VAT because of the ease of use of input-output data from the Department of Commerce, United Kingdom. His model was developed to handle various amounts of shifting of both the VAT and the corporate income tax (CIT). When it is assumed that the CIT is not shifted, but the VAT is fully shifted forward (consistent with traditional economic theory), prices rose relatively more in agriculture than in any other industry. Under the same shifting assumptions, the agricultural value added tax liability would be more than twice the corporate

income tax liability. The lumber industry also incurred a greater liability with the VAT. These industries would need to raise prices and/or lower one or more factor payments. In seven other industries VAT liabilities would be less than half the corporate income tax liability. Although the input-output model assumes zero demand elasticities, the results indicate that price changes would lead to substantial changes in demand.

While Dalamagas (1978) did not measure price effects, he did develop a statistical time-series analysis with indirect tax revenue as the dependent variable. Before its imposition in Greece, Dalamagas empirically estimated the expected VAT revenues versus other indirect taxing methods. In addition, he attempted to determine equity effects of the VAT on income; and whether housing status, age, or income have the greatest effect on equity. He ratified the statistical significance of variations in VAT burden across income, i.e., the regressivity of the tax. The results also indicated that income was far more important than age and housing status in determining VAT burden.

Although Aaron studied the price effects on several industries, he did not examine any particular commodity. Nor did he examine the consumption type VAT, which is the one most likely to be imposed in the United States. This

study is designed to fill that gap, using an econometric analysis (with demand elasticities) for short-run price effects in the forest industry, particularly for the southern pine stumpage owner.

MODEL DEVELOPMENT

Although Aaron studied (1968) the price effects on several industries, he did not examine any particular commodity. Nor did he examine the consumption type VAT, which is the one most likely to be imposed in the United States. This study is designed to do just that. An econometric analysis is used to determine short-run price effects in the forest industry, particularly for the southern pine stumpage owner.

Ideally, to study the probable effects of a VAT on private forestry, every forest product would be studied. On the primary product side, all species would be studied in the stumpage market; on the consumer side, all final products such as housing, paper, books, and so forth, plus the intermediate products and substitute products, would be incorporated into a national dynamic model. However, the complexity of such a model is beyond the scope of this study.

Instead, the scope is limited to a short-run model for privately owned southern pine sawtimber stumpage, and new one-family dwellings in the housing market. The model is limited to privately owned stumpage because of the difficulty in predicting how the tax will be imposed on public timber, as well as the uncertainty in interpreting

public stumpage price data. The limitation to southern pine is due to data availability and its proportion of the southern stumpage market (69 percent in USFS 1982).

As indicated earlier, the VAT is a tax shifted forward to consumers. Therefore, its effects must be measured in the consumption sector of the market. For the forest products industry, the consumption sector is arduous to specify. In the paper industry, many products are traded in the secondary market. The tax on boxes and paper bought in the process of doing business would be passed on to the consumer of non-wood products. In the lumber or particle board market, the same situation exists where many products are used in secondary markets. The new housing market is one consumer product directly linked to the forest products industry. Additionally, approximately 63 percent of southern pine sawtimber is used in residential construction.[1] Reseachers have extensively studied the housing market. Thus, the model is limited to new single-family houses.

The purpose of this section is to examine the effect of VAT on private forestry owing to a change in housing consumption predictably caused by an increase in the new

[1] This figure is not readily available, but was derived by A. Goetzl of the National Forest Products Association using various sources of information. See author for further details.

housing prices due to VAT. Since we use the consumption type VAT, calculated using the invoice method, we assume the tax is totally shifted forward. Furthermore, we assume the tax is added on and not substituted, so the change in price will be equal to the VAT rate. Housing consumption is used as a demand shifter for the price of stumpage sold, which impacts on the supply quantity as in a recursive system. When these values are adjusted, the change in revenue to the private forestland owner is identified.

Therefore, the supply and consumer demand function for new single-family houses is analyzed, as well as the supply and derived demand function for southern pine sawtimber stumpage. The estimations are important because: 1) there is little consensus among researchers about the appropriate form of the stumpage equations or the estimated levels of price elasticity of supply and demand, and 2) demand and supply equations are not readily available for stumpage.

Data

The first step in modeling these markets is to gather data. Some of the data available extends from 1955 to 1982, 28 observations; others extend only from 1963 or 1966 to 1982. To ascertain the missing data points, extrapolation methods are used. In some cases trend

extrapolation is used, in other cases linear regression is used in conjunction with the variables with longer available data series. Once the relationship are determined, the unavailable data are predicted and used with the available data in the model.

Average southeastern data on private stumpage are only available on a monthly basis form 1977-1983 in Timber-Mart South (TMS various issues). However, Louisiana (included in the TMS series) has price series from 1955 to the present, on private stumpage for both sawtimber and pulpwood. The sources for the Louisiana data are Ulrich (1981), Hair and Ulrich (1969) and LSDM (various issues).[2] A simple regression, using quarterly time series from 1977-1982, demonstrates the high correlation between southeastern prices and Louisiana prices (R^2=.8134 in the pulpwood market, and R^2=.6423 in the sawtimber market). Although Louisiana prices are higher than the southeastern average it is used as a proxy since we are not intersted in actual prices, but in the change in prices due to the VAT.

Standing timber inventory and removal data are collected occasionally for Forest Service Forest Resource reports. The data available are for 1952, 1962, 1970, and 1977 (USFS

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[2] The most current data are obtained through direct contact with the sources mentioned for many of the following variables.

1982, 1973, 1965, and 1958). The data are separated either by ownership in a region, or by species in a region, but not by both. The quantity in our stumpage supply curve is defined in terms of species in private ownership. Therefore, the four data points are weighted by the percentage of private ownership in the South before being extrapolated and interpolated to extend the data base to 1955-1982.

Other data used in the stumpage level of the model include Douglas-fir sawtimber stumpage prices found in Ulrich (1981) with recent data directly from the Forest Service. An average aggregae price for all lumber products is not available for the years specified, however a producer price index for southern pine lumber (1967=100) is available for 1955-1982, found in the U. S. Bureau of Labor Statistics (various issues).

In order to filter out the affect of a change in the size of houses built, housing quantity is measured in square feet and the price of housing in dollars per square foot. Therefore, housing demand is defined as the number of new single-family houses sold multiplied by the average square footage per single-family house sold. These data are available form the Bureau of Census (1981a) for the years 1963-1982. In order to ascertain pre-1963 figures a

quadratic trend extrapolation is used. (Figures in parentheses below the equations are standard errors.)[3]

$$\underset{\text{(959314.735)}}{\text{SQFTSOL1} = 7316370.991} + \underset{\text{(971.636)}}{7393.001(\text{YEAR})} - \underset{\text{(.246)}}{1.867(\text{YEARSQR})}$$

$$\underset{\text{(27.195)}}{-189.112(\text{D})}$$

with $R^2 = .9415$
$DW = 1.482.$

A qualitative variable is used, after noting the appearance of a shift in the trend on the scatter diagram (therefore D=1 when YEAR>1969). The number of houses sold is extrapolated from a simple linear regresion with housing starts data of the number of private farm and nonfarm units started in thousands of units (CEA 1962 and 1983).

$$\underset{\text{(68.744)}}{\text{SOLD1} = 153.354} + \underset{\text{(.043)}}{.2702(\text{STARTS})}$$

with $R^2 = .6866$
$DW = .3734.$

The two sets of predictions are multiplied together for square footage sold in 1955-1962, otherwise the original data are used.

The housing price variable is defined in dollars per square foot. Square footage per house is estimated above. Price of new single-family houses sold is available from 1963 through 1982. Earlier years are ascertained in a simple linear regression with the value of private new housing units put in place in billions of dollars to obtain estimates for 1955-1962.

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[3] See Appendix A for variable definitions.

$$PRICE1 = \underset{(2300.583)}{4349.787} + \underset{(.071)}{1.338}(VALUE) \quad \text{with} \quad R^2 = .9517, \; DW = .7335.$$

The predicted prices are divided by the predicted average square footage sold in 1955-1962, otherwise the actual values are used.

Mortgage interest rates for Federal Home Loan Bank Board (FHLBB) loans are also available for 1963-1982 (CEA 1983). To estimate earlier figures a linear relationship is used with Moody Aaa corporate bond rates (CEA 1983).

$$MORTGAG1 = \underset{(.2782)}{1.1724} + \underset{(.033)}{.9553}(MOODY) \quad \text{with} \quad R^2 = .9789, \; DW = .5117.$$

To approximate the effect of previously built houses available for sale, year round annual average vacancy rates, as a percentage of all units, are used. These data are available from 1956-1982. Since it is not desirable to loose another observation, and the data available shows a high degree of stability, especially in 1956-57, and again in 1968-78, an estimate equal to the vacancy rate in 1956 is used for 1955. These data are found in U. S. Bureau of Census (1981b and 1975).

Finally, per capita disposable income and the rent portion of the CPI, variables in the housing demand equation, are available for 1955-1982 (CEA 1983).

All price variables in this model are deflated with he consumer price index and expressed in 1967 dollars. Those variables affected are the price of southern pine and Douglas-fir sawtimber and pulpwood stumpage, the lumber price index, the price of houses sold, per capita disposable income, and rent.

Appendix B lists the data used for the econometric analysis. The estimated regression to generate data are graphed in Appendix C.

Model Specification

Background

Stumpage Market. The literature on stumpage market analysis is somewhat limited. Luppold (1981) refers to this fact in his econometric study of hardwood stumpage supply and demand. Since some sawmill operations are vertically integrated and purchase their own stumpage, while other firms purchase logs, he states that it is difficult to separate aggregate demand for stumpage from aggregate demand for logs. Luppold then models the hardwood lumber market using quantity supplied and demand price as the two endogenous variables. He estimates the parameters using a double-log form which results in a short-run elasticity estimate for the price variable. Results from this

investigation show a 1 percent increase in stumpage price leads to a .08 percent decrease in quantity supplied, and a .28 percent decrease in quantity of stumpage demanded, and a .54 percent decrease in the lumber price.

McKillop (1967) pioneered the first econometric study in the forest products market. He endeavored to specify an aggregate demand and supply relationship in the United States for lumber, paper, paperboard, plywood, roundwood, and stumpage. Additionally, he planned to estimate the structural parameters of these relationships, and provide a quantitative assessment of the elasticities and their relative importance in determining consumption and price levels during the sample period. The structural equation for stumpage supply (consisting mostly of Douglas-fir) was modeled as a function of the price of stumpage and the year. This trend variable was proposed to recognize the changing physical availability of timber. However, the stumpage supply equation was not estimated because the information on it was used indirectly in estimating other relationships.

Stumpage demand was also modeled but not estimated due to data unavailability. This model attempted to capture the derived nature of stumpage demand by collapsing three market levels into one equation. McKillop used price of stumpage, prices of logs, and price of higher level products such as

lumber, paper, paperboard, and plywood. Some consider this technique to be double counting leading to severe multicollinearity problems.

Adams and Haynes (1980) presented a spatial model of North American softwood lumber, plywood, and stumpage markets designed to provide long range projections of price, consumption, and production trends. In the stumpage sector, aggregate demand interacts with supply to determine equilibrium stumpage prices and harvests on a regional basis. Adams and Haynes used a two stage least squares (2SLS) estimation technique with only 10 years of data (1966-1976). Their model for aggregate derived stumpage demand was notably different from most others. Total stumpage demand was expressed as a function of product recovery factors for lumber and plywood, lumber and plywood output, roundwood requirement for pulp output, and other miscellaneous products output. Their supply equation was similar to McKillop's, identifying quantity supplied as the cut or cut/inventory ratio in the area, being a function of price of stumpage and inventory. The supply of stumpage was separated by ownership class and region, but not by species.

Adams (1977), attempted to simulate the response of output prices to national forest Douglas-fir supply. He used price as the endogenous variable in the demand

equation. For this investigation, time series data and ordinary least squares (OLS) was used for statistical analysis.

Adams and Blackwell (1973) developed a 15 equation model of the forest products industry in the United States. This model linked the principal structural elements of markets for lumber, plywood, sawlogs, veneer logs, and stumpage. The stumpage sector was modeled by a single demand price equation. This investigation also used time-series data and OLS for statistical analysis. Adams and Blackwell thoroughly reviewed the economic relationships and the structural parameters necessary in modeling stumpage in general.

Finally, Robinson (1974) modeled the demand and supply of Douglas-fir and southern pine lumber and stumpage. Robinson recognized that stumpage was consumed in various end uses, but intended to keep his model simple. Therefore, he assumed stumpage quantities demanded to be equal to the quantity of lumber supplied. However, after repeated estimates, Robinson found a zero coefficient on the price of southern pine in its own lumber demand equation. This implied an infinitely inelastic demand for southern pine lumber and stumpage. The quantity demanded was treated as a predetermined variable. As a result, his six equation model

depicting the southern pine sector collapsed into two price relations representing the supply of lumber and stumpage. 2SLS was used to estimate the coefficients, using annual observations for the period 1947-1967.

Housing Market. There is a great deal of literature on housing demand; however, this investigation is specifically interested in the supply and demand of new houses built or constructed, rather than housing demand in general. Since we are tracing the effects of the value added tax on stumpage demand and prices, the final market must be the current market of wood use.

Muth (1960) attempted to model both supply and demand for non-farm housing. He hypothesised that the long-run price of housing determined desired stock demand, and the short-run deviations in price governed the rate at which the desired stock was approached. Using OLS, he found long-run supply of new housing to be perfectly elastic.

Follain (1979) pursued Muth's results, specifically testing whether the long-run supply of new residential construction was perfectly elastic. Follain used contemporary data, consequently a longer time series, and both OLS and 2SLS regression on linear and log-linear equations in order to investigate this hypothesis from every angle. The results were the same as Muth's; a perfectly

elastic long-run supply curve for new construction was sustained.

Pollock (1974) used cross-sectional data to estimate demand and supply functions for new residential construction. He refuted the hypothesis that supply is perfectly elastic, contending the supply function is price inelastic. The study gave a thorough review of the economic variables affecting the housing market.

Similarly, Maisle (1963) reviewed the economic causes of changes in demand for housing construction. His theoretical model encompassed all the variables determining household formation, net housing removals, changes in vacancies, and changes in inventories under construction. His empirical model was reduced to a single equation for housing starts and time series data was fitted using OLS regression.

Problem Review. In order to investigate the possible effects of a value added tax on forestry, the direction of the tax-shifting and the factors affecting shifting must be defined. As mentioned earlier the tax is expected to be shifted forward, but not completely. If initially the tax is totally shifted forward, all prices will rise, and consumers with the same income will have less buying power, thus depressing consumption. A decrease in consumption will then lead to lower prices, or a partial backward shifting to the suppliers of stumpage.

The main purpose of this model is to explain the effect of the VAT rather than explain the supply and demand situation for both stumpage and housing construction. Therefore, the model must concisely identify each market. Moreover, it must sufficiently identify the causes of fluctuation in each market so that accurate weights (coefficients) are assigned to each of the variables, particularly the price variables. House prices will be altered by the introduction of the tax. The model developed is used to determine what effect initial price change for housing will have on quantity consumed in both the housing and stumapge market level, and in the price of stumpage net of the VAT.

The expected long-run supply-demand equilibrium system for housing is modeled in Figure 1a. Before the VAT is imposed, the equilibrium price is Po = Po + v(Po), where v represents the VAT rate and equals zero. After the value added tax is first imposed, v would increase, the price would rise from Po to P', and an initial surplus of Q'Qo would exist. In the long-run, to reduce this surplus, suppliers would reduce the price until the total quantity supplied is bought. When prices are reduced, some suppliers will drop out, causing a leftward shift in the supply curve (the shifted supply curve does not necessarily have the same

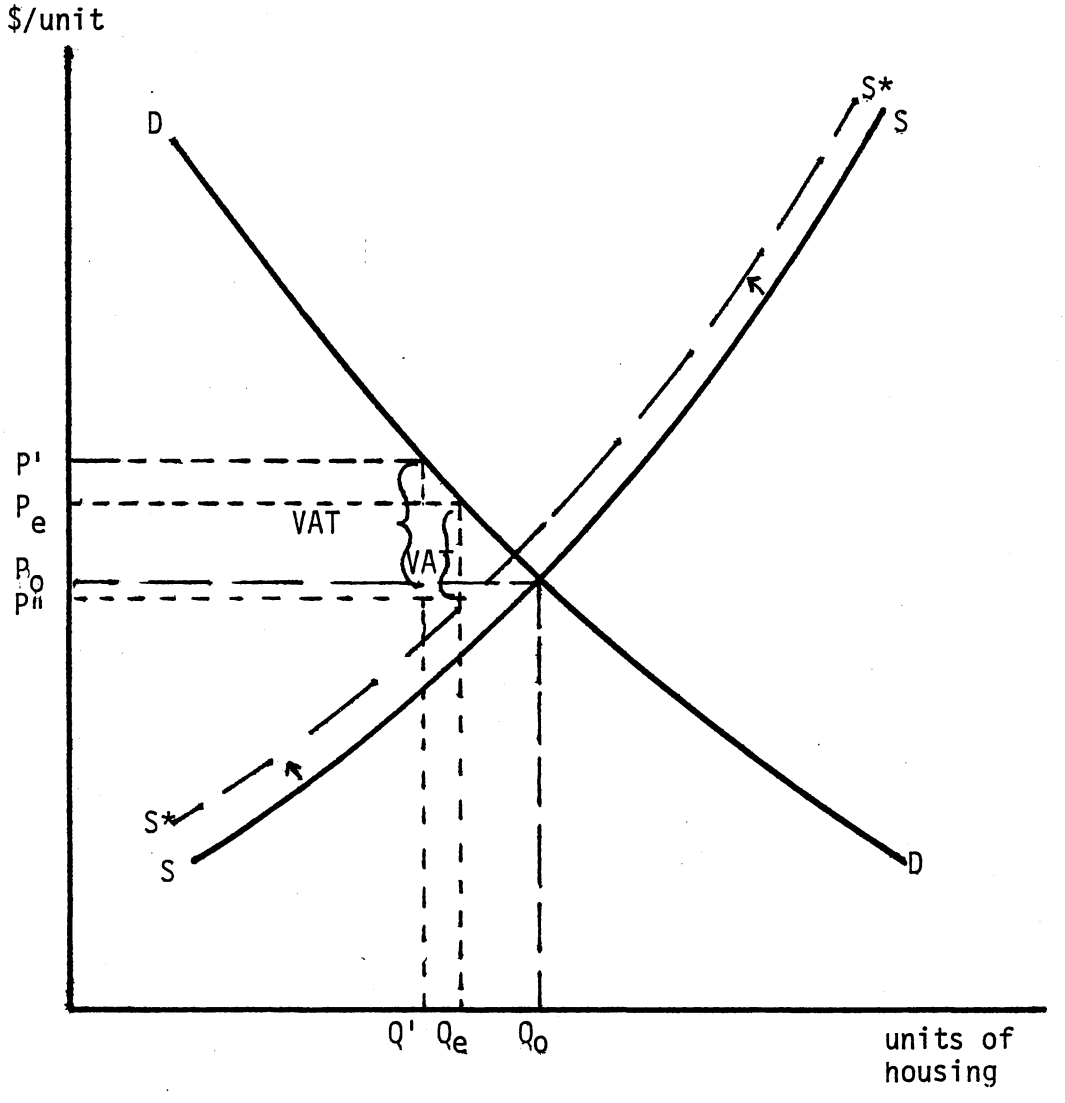

Figure 1a. Long-run VAT-Shifts on the New Housing Market.

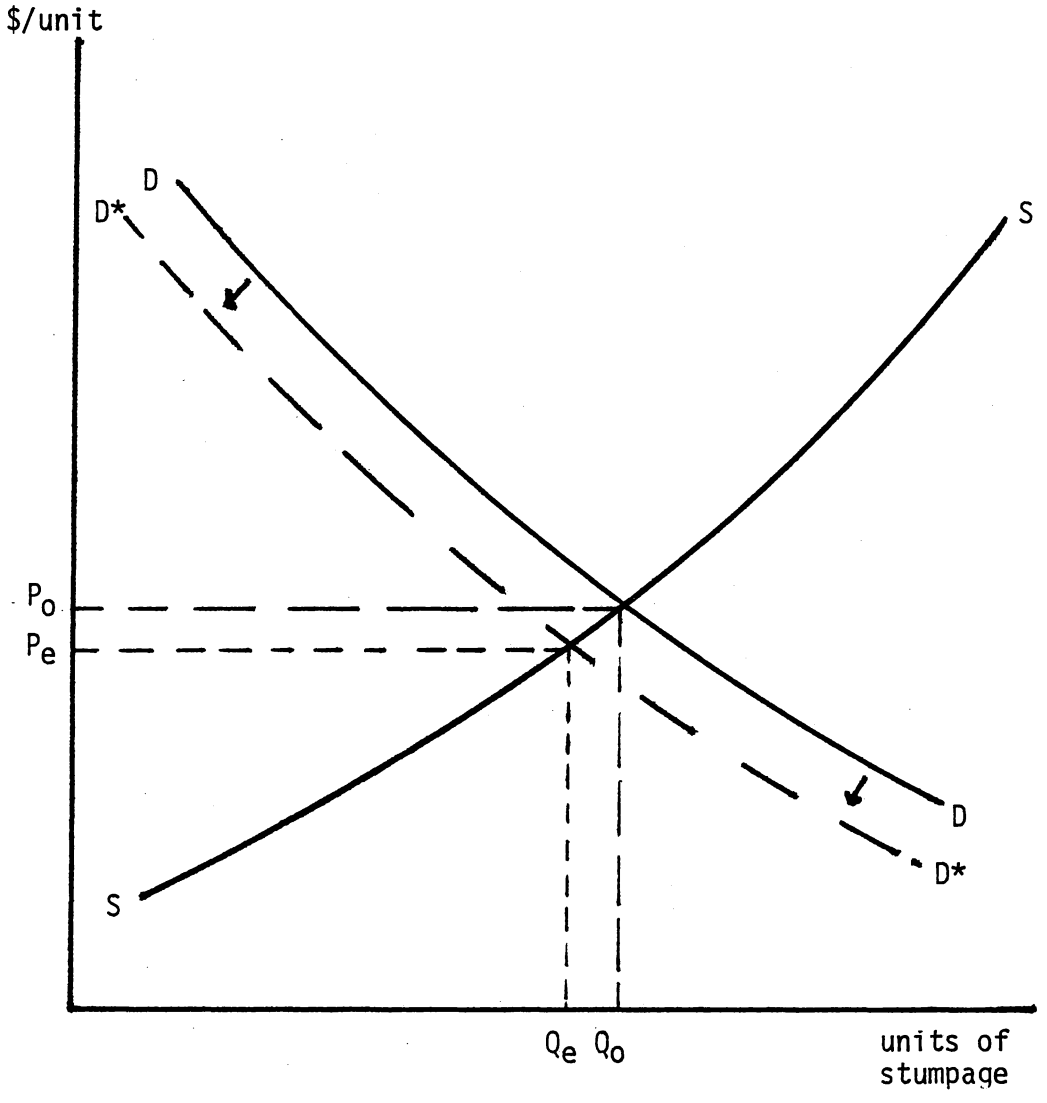

Figure 1b. Long-run VAT-Shifts on the Sawtimber Stumpage Market.

slope as pictured). Equilibrium would occur at some point between P'Po; i.e., Pe will be the equilibrium price to the consumer at quantity Qe. Note that this is the consumer's supply and demand equilibrium. The supplier will receive only P", where the difference between Pe and P" is the value added tax still due to the government. However, in the very short-run, the case examined here, the initial price rise would remain the equilibrium price and a surplus quantity would exist.

The change in housing price will be translated into the stumpage market through the quantitiy of housing sold (housing demand). After the housing quantity changes from Qo to Qe, the demand function for stumpage will be shifted to D** in Figure 1b, resulting in a new price for stumpage (Pe*) and a new equilibrium quantity sold (Qe*) and finally, a lower revenue (Qe*)(Pe*) to the stumpage owner.

In the long-run, the degree to which a VAT could depress consumption of a particular good depends on the price elasticity of supply and demand for that good (Smith 1973 and Garner 1979). Figure 2 diagrams several cases of different elasticities when the VAT is imposed. When the elasticities of supply and demand are the same at intersection points, i.e. both inelastic, or both elastic

(Figure 2a and 2b),[4] the changes in price (P'Pe) are approximately equal. However, in the same cases, the change in quantity (QoQe) decreases as elasticity decreases. Thus, the revenue change is greatest in the elastic case and smallest in the inelastic case.

When demand is less elastic than supply, Pe is greater than the Pe of the cases described above (Figure 2c). Also, when demand is more elastic than supply (Figure 2d), Pe is less than the Pe of Figure 2a and 2b and is closer to the original pre-tax price.

Demand and supply elasticity estimates for several forest products are noted to be relatively inelastic (Adams 1977, 1976, Haynes 1977, Holly and King 1978, Holly 1970, Josephson 1975, Schuler 1978, and Vaux 1970). However, Follain (1979) and Muth (1960) find housing supply is perfectly elastic--the short-run situation assumed in this study as shown in Figure 3. A priori the demand elasticity is unknown. In this case, equilibrium price will be P', or Po plus the VAT. Suppliers will not alter their prices in the short-run. This assumption is often reasonable since in the short-run, if the sale price for houses rises, builders will be willing to build more houses, but in a local market,

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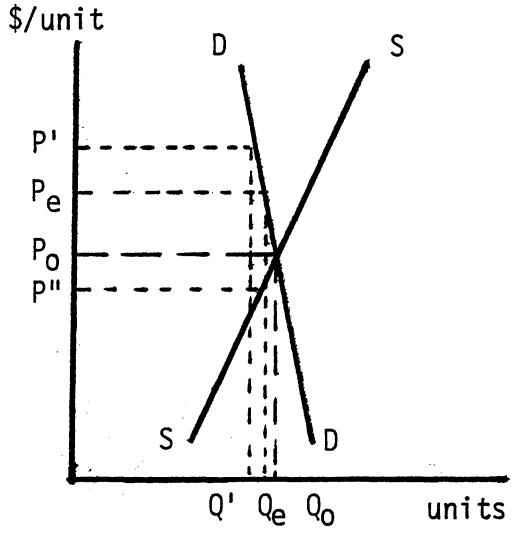
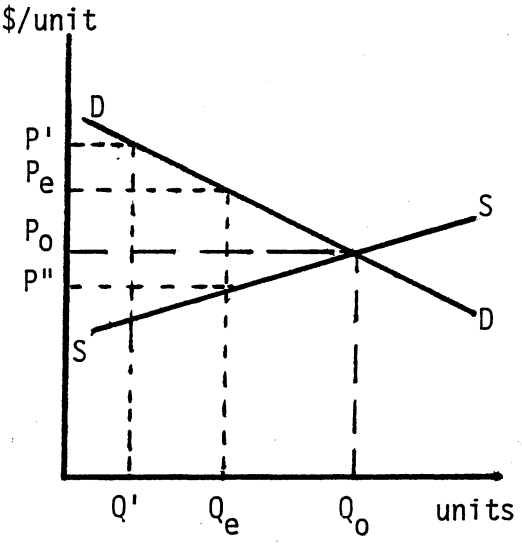
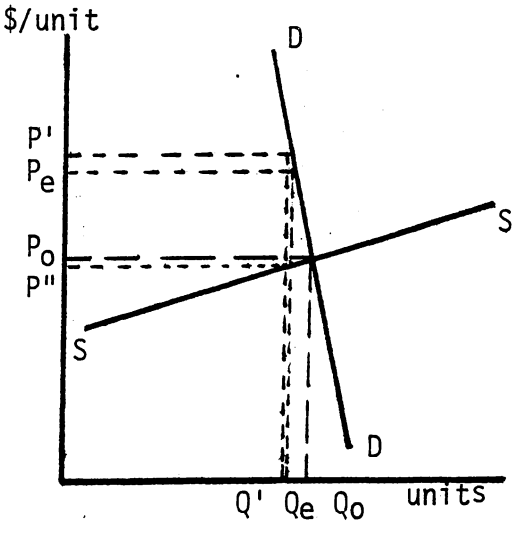
[4] Figure 2a-2d show an equilibria ignoring the supply curve shift. Figure 1a demonstrates the supply curve shift most likely to occur.



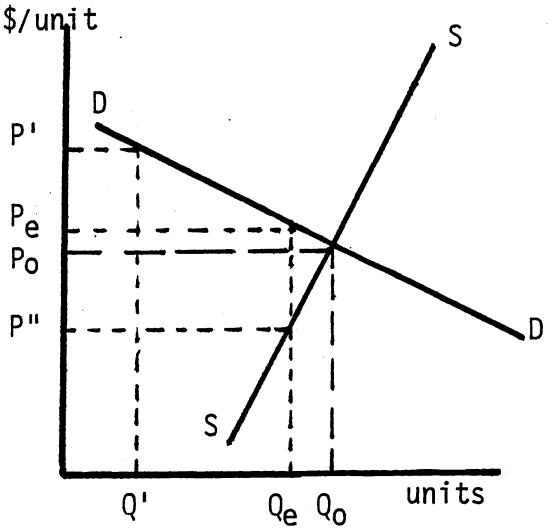
(a) Demand and Supply Inelastic



(b) Demand and Supply Elastic



(c) Demand Inelastic; Supply Elastic



(d) Demand Elastic; Supply Inelastic

Figure 2. Effect of Different Elasticities on Equilibrium Price.

increased building activity will not drive up production costs. Regional lumber markets will be unaffected, and the wage rate will remain constant given a reasonable assumption of unemployment among unskilled laborers. The key is that the housing market is disaggregated into geographic areas. Summarizing, the marginal cost of building a house will often not increase in the short-run.

Model Construction

Total Structural Model. Three equations are developed and combined into a recursive system.

$$HS = f(PRSQFT, CAPINC, MORT, VAC, RENT)$$

$$SPPRIC = f(DFPRIC, LUMPRIC, HS)$$

$$REMOVAL = f(SPPRIC, PULPRIC, INVENT).$$

Housing demand is first determined endogenously, then stumpage price is influenced by housing demand. Finally, stumpage quantitiy supplied is determined by stumpage price. Since the matrix of endogenous coefficients is lower triangular, the model satisfies the structural requirements for recursive systems (Kmenta 1971).

Initially, the specific market variables to be used as measures of shift in southern pine stumpage demand and supply, as well as housing construction demand are determined. To do this, major factors influencing supply

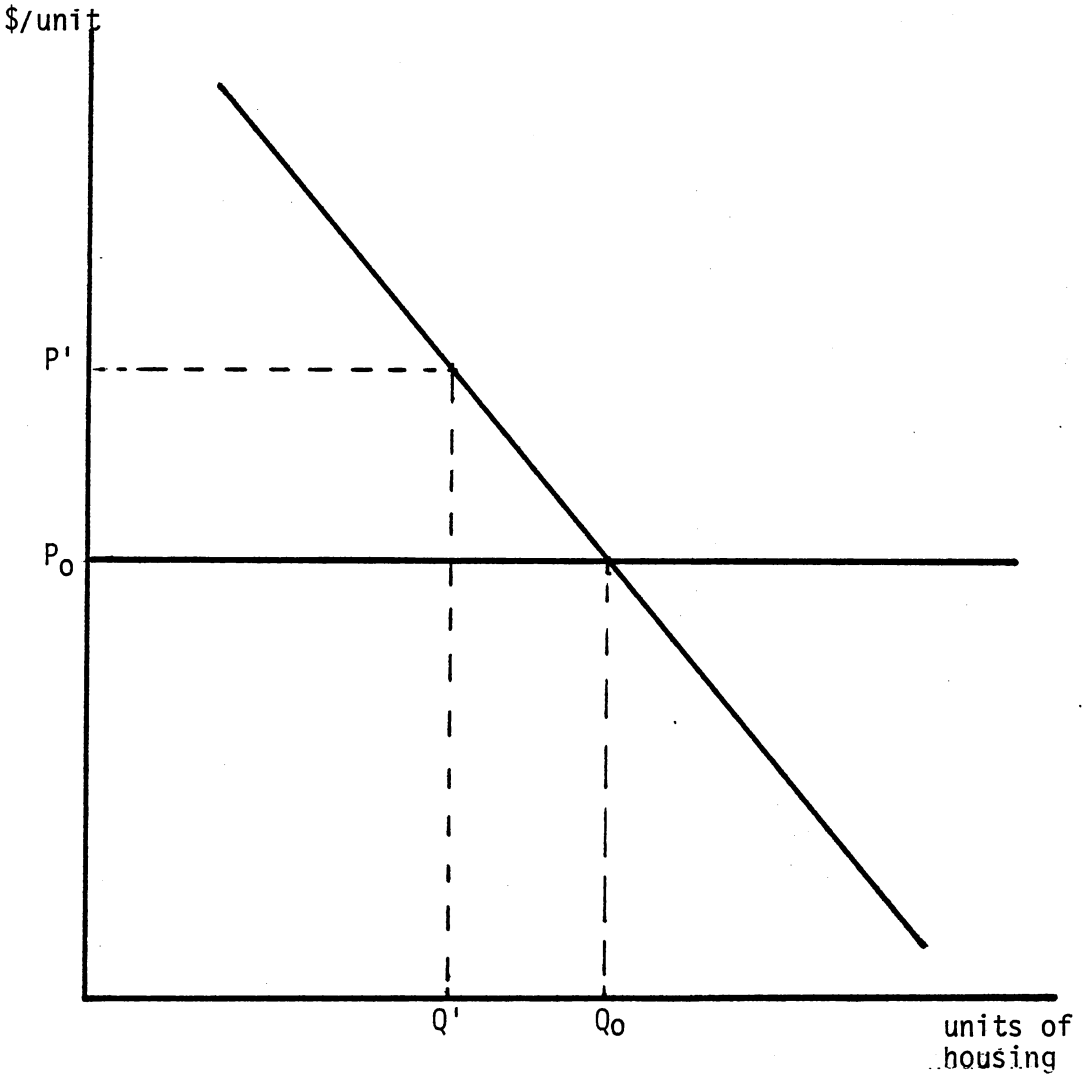


Figure 3. Short-run Housing Market.

and demand in these markets are identified. Criteria for choosing these factors include: (1) closeness of a historical functional relationship between the independent and the dependent variables; (2) causality of the relationships between the independent and dependent variable; and (3) availability of data. The expected relationships are also identified a priori where possible.

New Housing Construction Demand Model. In formulating the demand model for new housing, the models developed by past researchers (noted in the Background) are drawn from heavily. The measure for housing demand or consumption is the number of new single-family houses sold multiplied by the average square footage per house. The price of housing is an important predetermined factor traditionally linked with the demand for housing. It has an inverse relationship with quantity, therefore, a negative sign on the coefficient is expected.

Another factor influencing demand is per capita disposable income acting as a general economic indicator as to whether houses are in demand. Since income has a positive relationship to housing consumption, a positive sign on this coefficient is expected.

Mortgage interest rates are used as measure of the price of money, or the difficulty of borrowing money in order to

buy houses. As mortgage interest rates rise, less houses will be bought. A negative sign on the coefficient for interest rates is hypothesized.

Finally, a vacancy rate index and the rent portion of the consumer price index (CPI) are used as measures of substitutes to new housing consumption. The vacancy index has a negative relationship with housing consumption. The more readily available old houses are, the less new houses will be bought. A negative hypothesized looked for on the coefficient on vancancy rates. On the other hand, the rent portion of the CPI measures the change in rent prices, and if price on a substitute rises, quantity of housing consumed will rise as well. Therefore, a positive sign on the coefficient is predicted.

The function takes the following hypothesized form:

$$HS = bo - b1\ PRSQFT + b2\ CAPINC - b3\ MORT - b4\ VAC + b5\ RENT,$$

Southern Pine Stumpage Demand Model. Demand for stumpage is a derived demand (Foote 1958). The demand price of southern pine sawtimber stumpage is endogenously modeled.

The price of a substitute good, Douglas-fir stumpage, is identified as a positive influencing factor on the price of southern pine. Therefore, a positive sign on its coefficient is expected.

The price of southern pine lumber is the next factor considered as a demand shifter. Output price has a positive relationship with the price of a product. The sign looked for on the coefficient for lumber price is positive.

The quantity of housing sold in square footage is used as a general economic indicator. As it increases, price of stumpage is expected to increase. A positive sign is predicted on the coefficient for the demand shifter.

The function is hypothesized to take the following structural form:

$$SPPRIC = bo + b1\ DFPRIC + b2\ LUMPRIC + b3\ HS,$$

Southern Pine Stumpage Supply Model. Southern pine sawtimber stumpage supply is measured by removals in MBF (thousand board feet) of privately owned southern pine sawtimber. The following factors influencing supply are identified. First, price of southern pine sawtimber stumpage is a predetermined variable shifting the quantity supplied. It is traditionally economically postively linked to the quantity of stumpage produced. A positive sign on the coefficient for price is predicted.

The price of southern pine pulpwood is also expected to influence supply. However, the relationship of pulpwood to sawtimber has not been *a priori* identified in the

literature. Pulpwood may be a competitor with a negative relationship reflecting sawtimber suppliers competition with pulpwood suppliers for the same resource base. This would lead to a negative sign on the coefficient for pulpwood prices. Alternatively, it may be a complement in production since harvest of a sawtimber stand rarely produces sawtimber exclusively, resulting in a positive linkage, and a positive sign on the coefficient.

Finally, stumpage supply is expected to be an increasing function of current standing timber inventory. Stumpage inventory must increase in order for removals to increase. If not, the resource base will be depleted, leaving future supply in doubt. The sign on the coefficient of inventory is expected to be positive.

The function takes the following hypothesized form:

$$REMOVAL = bo + b1\ SPPRIC \pm b2\ PULPPRIC + b3\ INVENT,$$

Estimation Procedure

Estimates for coefficients on each of these variables are made using simultaneous estimation techniques on a recursive system. Although the matrix of endogenous variables is lower triangular, satisfying the structural requirements for a recursive system, the matrix of the variance-covariance

terms is a *priori* unknown. The use of OLS in estimating a recursive model requires the latter matrix to be diagonal (Kmenta 1971). However, correlation of the disturbance terms is expected among equations.

Therefore, two and three stage least squares are used to obtain estimates of the structural parameters. The analytically derived reduced forms are then estimated with each endogenous variable a function of all predetermined variables.

Estimates obtained from both 2SLS and 3SLS are consistent, that is, as the sample size increases indefinitely the estimates tend to their true population values. However, the estimates lack small sample properties such as unbiasedness and minimum variance. Since the sample used in this study is small, 28 observations, the results obtained should be interpreted with caution.

RESULTS OF THE ECONOMETRIC ANALYSIS

This investigation results in short-run price and quantity percentage change estimates for the southern pine sawtimber stumpage market due to a price increase at the consumer level, specifically the new-housing level. Emphasis is placed on directional rather than absolute impacts on equilibrium price and quantity. Although absolute figures are reported, they are meant to indicate the direction and magnitude of impacts, not to suggest point estimates.

The data base is small, therefore caution must be used when interpreting the results. A complete summary of statistics on the data set can be found in Appendix D.

Structural Estimates

Initially, both two and three-stage least squares estimation techniques are used to obtain parameter estimates for the structural equations. Subsequent steps to estimate the coefficients for the variables and the resulting elasticities are performed using the three-stage least squares estimates alone. 3SLS is used partly because of the

improvement in standard error of the parameter estimates. More importantly, 3SLS estimation techniques explicitly account for correlation between equations, therefore the resulting estimates are more efficient.

The estimates for 3SLS are (figures in parentheses below the equation are standard errors)

REMOVAL = - 322032 + 24380 SPPRIC - 267056 PULPPRIC
(1436152) (9574) (267861)

+ .061329 INVENT.
(.002945)

SPPRIC = - 6.8253 + .258532 DFPRICE + .278553 LUMPRIC
(8.998) (.034237) (.099114)

+ .56998X10-5 HS.
(.56294X10-5)

HS = 650230 - 36522 PRSQFT + 538.9 CAPINC
(1427527) (9318) (156.7)

-338119 MORT - 182695 VAC + 27436 RENT.
(54782) (73885) (5533)

The parameter estimates conform to a priori expectations. The sign of the coefficient for southern pine pulpwood price in the southern pine sawtimber supply equation, which was a priori unspecified, is negative. For the data used, this indicates pulpwood is a competitior in the production of sawtimber.

All the intercept estimates and the pulpwood price coefficient are insignificant at any reasonalbe level of

significance, having standard errors greater than the estimate. The coefficient for houses sold in the stumpage demand equation is only marginally significantly different from zero. In general parameter estimates are judged to be statistically significant if they are at least twice their associated standard error (Kelejian and Oates 1981).

When using 3SLS estimation techniques, statistical quantities related to least squares procedures and tests of hypotheses on regression parameters are no longer strictly valid. Therefore, the coefficient of determination (R^2) measuring the models explanatory power, and the Durbin Watson Statistic (DW) measuring serial correlation of distrubance terms within each equation are not reported. These statistics, or some measure of them, are reported with the analytically derived reduced form estimates.

Analytically Derived Reduced Form Estimates

Multiple endogenous variables in the individual structural equations when using simultaneous estimation techniques lead to difficulties of interpreting structural coefficients. When interpreting an individual coefficient using 2SLS or 3SLS, all other variables in the equation cannot be assumed non-variant. Hence, a problem develops in trying to assess the impacts of changes in particular

variables using the estimated structural coefficients. That problem concerns whether the estimates depict the net or gross effects of changes in their respective variables. To circumvent this issue, the net impacts of changes in exogenous variables on endogenous variables can be conveniently assessed using the analytically derived reduced forms. These forms can be used to predict the values of the endogenous variables since each endogenous variable is expressed as a function of all exogenous variables (Kmenta 1971). Consequently, this estimation technique is used to obtain estimates which explain the impacts of a change in price at the consumer level, on all the endogenous variables in this model.

When using this technique, each endogenous variable is a function of all predetermined variables in the strucural equations. The matrix of predetermined variables is multiplied by the inverse matrix of endogenous variables. If a predetermined variable is omitted from a particular equation, it is the result of a zero estimate for the coefficient. The reduced form equations are:

REMOVAL = - 398076 - 267056 PULPPRIC + .061329 INVENT (1)
+ 6303 DFPRICE + 6791 LUMPRIC - 5075 PRSSQFT
+ 74.88 CAPINC - 46985 MORT
- 25375 VAC + 3812 RENT.

R^2 = .984.

$$SPPRIC = -3.119 + .258532\ DFPRIC + .278553\ LUMPRIC \quad (2)$$
$$- .208169\ PRSQFT + .003071\ CAPINC - 1.9272\ MORT$$
$$- 1.0408\ VAC + .156379\ RENT.$$

$$R^2 = .955.$$

$$HS = 650230 - 36522\ PRSQFT + 538.9\ CAPINC \quad (3)$$
$$- 338119\ MORT - 182605\ VAC + 27436\ RENT.$$

$$R^2 = .893.$$

The coefficient of determination (R^2) is calculated by first determining the correlation between the actual value of the endogenous variable and the predicted value using the estimated coefficients. R^2 is the correlation term squared.

To determine the serial correlation within an equation, the non-parametric runs test is performed on the residuals of the actual value and the estimated value of each endogenous variable. The results are as follows

Equation (1) Zobs = -2.98

Equation (2) Zobs = -2.57

Equation (3) Zobs = -3.07.

The statistical evidence indicates the presence of serial correlation in each of the derived reduced-form equations.[5]

[5] An attempt was made to correct for autocorrelation using ordinary least squares estimates in a Koyck lag correction procedure. However, after the analytically derived reduced forms were recalculated, the non-parametric runs test on the residuals indicated serial correlation within

Elasticity Impacts of the Price of Housing

The analytically derived reduced form estimates result in impact multipliers in each equation. Therefore, the point elasticities of the predetermined housing price variable can be determined for each of the endogenous variables.

Typically, point elasticity is measured in terms of a ratio of the percentage change in quantity (q) of the variable in question to the associated percentage change in price (p), or

$$(\Delta q/q)/(\Delta p/p) = E \qquad (4)$$

$$(\Delta q/\Delta p) \cdot (p/q) = E \qquad (5)$$

The first term of equation (5) is the impact muliplier (M), which measures the impact on the endogenous variable of a unit change in the value of the exogenous variable. This is the coefficient for housing price in the estimated analytically derived reduced forms. The specific equations for housing price elasticities are

$$E(REMOVAL) = M(1)\ (PRSQFT/REMOVAL)$$

$$E(SPPRIC) = M(2)\ (PRSQFT/SPPRIC)$$

$$E(HS) = M(3)\ (PRSQFT/HS).$$

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each equation.

Point elasticites are calculated using the available data for average and 1982 figures. For example (using 1982 figures):

$$E(REMOVAL) = (-5075)(\$17.1722 \text{ per MBF}/19,251,463 \text{ MBF})$$
$$= -.004527.$$

The most recent data available, 1982 figures, are used assuming the VAT will be imposed when prices and quantities are most like current figures. Hence, 1982 data are a proxies for prices and quantities in the year the tax is imposed. Average figures are also used, since a regression line will always pass through the centroid of the data Therefore, these figures represent an actual point on the line estimated by the analytically derived reduced form equations. The results can be seen in Table 5.

Two things are notable in the table: first, the difference in magnitudes between 1982 and average figures; and second, the difference in magnitude between endogenous variables, or the levels of the recursive system. The former is due to the variation within each data series. The latter is partly due to the market levels and partly to the short-run nature of the model. At the retail level, the consumer has demand substitutes. For example, the housing consumer may choose to rent, to buy an old house, or to stay

TABLE 5

Housing Price Point Elasticities

Endogenous Variable	Elasticities (percent) 1982	Average
New Single-Family Houses Sold	-.900739	-.848441
So. Pine Sawtimber Stumpage Price	-.071494	-.082728
So. Pine Sawtimber Stumpage Quantity	-.004527	-.007278

in his current position when new housing prices rise. On the other hand, especially in a derived demand situation, the primary market may have no substitutes. The lumber or plywood producer must use stumpage. Therefore, while the demand for housing is only slightly inelastic, the demand and supply of stumpage due to price changes for housing is very inelastic in the short-run. The decrease in changes is also due to the fact that this is a short-run ana changes. In the forest products industry, it may take longer than one year to transport the effects of housing price changes to stumpage prices, and even longer to stumpage supply quantities.

Impacts of a Change in Consumer Price Due to VAT

Under the assumptions set forth in this study, the VAT will be an add on tax completely shifted forward to the consumer in the first round. The short-run effects of such a price change on the housing and stumpage market can be measured using elasticities. The definition of an elasticity states that a one percent change in price (of housing in this case) will yield an X percent change in the level of the variable in question. X equals the elasticities calculated earlier. Thus, a one percent VAT rate will lead to a .9007 percent decrease in the quantity

of housing sold, a .0715 percent decrease in the price of southern pine sawtimber stumpage, and a .0045 percent decrease in the quantity of stumpage sold using 1982 figures. The interpretation is the same using average figures.

The impact of VAT on the private forest industry can be measured as a decrease in stumpage revenue. For all of the South, as defined by the data, a one percent VAT would approximately result in a .076 percent decrease in gross revenue due to the stumpage owners. This is calculated by first using the elasticities to find the actual changes in price and quantity for specific data. After a new revenue is determined, the percent change in revenue is calculated. The actual magnitude of the decrease in revenue will differ for each land owner depending on the price he can get for his timber and the quantity cut from his stand.

Sensitivity of Impact to Different VAT Rates

Several VAT rates have been suggested for use in the United States. Furthermore, on a continuum, any rate may be choosen if the VAT is implemented. Seven possible rates are depicted in Table 5, demonstrating the differences in changes of each for the endogenous variables and gross stumpage revenue.

TABLE 6

Percent Changes in the Endogenous Variables

VAT rates (percent)		Housing Sold (percent)	So. Pine Stumpage Price (percent)	So. Pine Stumpage Quantity (percent)	South-wide Stumpage Revenue (percent)
1	1982	- .9007	- .0715	- .0045	- .076
	Average	- .8484	- .0827	- .0077	- .0906
1.5	1982	- 1.3511	- .1072	- .0068	- .114
	Average	- 1.2727	- .1241	- .0116	- .1357
2.35	1982	- 2.1167	- .168	- .0106	- .1786
	Average	- 1.9938	- .1944	- .0182	- .2125
5	1982	- 4.5037	- .3575	- .0226	- .380
	Average	- 4.2422	- .4136	- .0386	- .4521
10	1982	- 9.0074	- .7149	- .0453	- .7598
	Average	- 8.4844	- .8273	- .0773	- .9039
15	1982	-13.511	-1.0724	- .0679	-1.1396
	Average	-12.7266	-1.2409	- .1159	-1.3554
20	1982	-18.0148	-1.4299	- .0905	-1.5191
	Average	-16.9688	-1.6546	- .1546	-1.8066

*Assumes full forward shifting of VAT so a one percentage change in VAT is analagous to a one percent increase in housing prices.

Though a one percent change is the measure of elasticity, it is also the rate suggested by Feldstein in Business Week (June 1983). Reckers and Bates (1980) mentioned a 1.5 percent VAT. The Single Business Tax Act (Michigan 1975) now uses a rate of 2.35 percent. The Tax Restructuring Act of 1979 recommended a reduced rate of five percent and a normal rate of 10 percent (Price Waterhouse 1979). Finally, the VAT rates used in the EEC range from 10 to 20 percent or more on normal goods. Specifically in the United Kingdom, which has been the European experience most extensively studied by American economists, the VAT rate is 15 percent (Price Waterhouse 1979). The rates suggested in the Tax Restructuring Act and those used in the EEC are linked to a substitution of the VAT for another tax system. Since it is now expected that the VAT will merely be added on to the current tax structure, which is the assumption of this model, a low rate is predicted.

The impact on the endogenous variables increases as the rate of VAT increases, assuming the elasticity remains the same throughout. The figures in Table 6 are calculated simply by multiplying the elasticity which represents a one percent VAT by the other suggested rates.

$$R \times E(1) = C$$

R = rate of VAT
E(1) = elasticity for stumpage supply equation
C = new percentage change due to VAT.

or, for a 1.5 percent VAT, the percent change in stumpage removals is

$$(1.5)(-.0045) = C$$

$$-.0068 = C.$$

Since elasticities are based on infinitesimal changes, large VAT rates would lead to increases in the variance associated with the elasticities. Thus, although the change in price and quantity at the housing level is nearly equal to the amount of the tax, the short-run effects at the stumpage level are small compared to the increased revenue obtained by the government.

Other VAT rates which may be imposed on housing sales are a regular exemption and a reduced rate. As demonstrated earlier, the special treatment at the consumer level would affect prices. To determine the change in sales price, figures for the price one market level earlier are necessary, specifically the cost of construction per square foot. Elasticity estimates would not change, but calculation of VAT impacts are more complex since the price would not rise by the full tax rate. Computation of these impacts on the stumpage level are beyond the scope of this investigation.

Table 6 does not give the revenue change for an individual, however individual landowners can estimate their

own short-run decrease in revenue using these calculations. First, he can determine the percent changes in stumpage price expected from the VAT rate being proposed. He may then multiply his expected post-VAT price by expected MBF/acre of sawtimber harvest to determine his revenue. The ratio of the difference between the pre-VAT revenue and the post-VAT revenue to the original revenue per acre is the percent change in the landowner's revenue.

SUMMARY AND CONCLUSIONS

The goal of this study is to examine short-run impacts upon private forest management in the United States, if a value added tax (VAT) were imposed. After reviewing the VAT literature, an econometric model is developed to examine the effect of a VAT-induced increase in new housing prices on the southern pine sawtimber stumpage market. New housing is assumed to be representative of all forest products. Similarly, southern pine sawtimber is assumed to be representative of the stumpage market.

In addition to dissatisfaction with the current federal deficit, many tax experts are dissastified with the current taxing systems. The VAT has been considered for use nationally several times, but has never been imposed. Meanwhile, forest economists are also seeking more equitable systems of taxation for forest lands. Therefore, it seems timesly to examine the possible impacts on forestry if a value added tax were imposed to solve certain tax problems.

We first define the VAT as a tax levied on the increase in value of a product or service at each stage of the production and distribution chain. It is a tax on wages,

interest, rents, profits, and other factors not received as taxable inputs.

Three types of VAT exist: national income type, gross national product type, and consumption type. The third is used exclusively in the European Economic Community (EEC), and is the one most likely to be imposed on a federal scale in the United States because it allows a firm to recover the full amount of the VAT paid on capital goods at the time of investment. This investigation singles out the consumption type VAT calculated with the invoice method under which the VAT is added to the product price on the invoice.

A uniform VAT rate on all products is rarely applied. Common adjustments to the VAT rate include a reduced rate, a zero-rating, or a normal exemption. These adjustments will only affect the consumer price of an item in the short-run if it is applied at the consumer level rather than at lower market levels.

On the basis of the European experience and the Tax Restructuring Act, multiple rates and exemptions would probably affect private forestry if a VAT were imposed in the United States. Many intermediate forest products, production factors, and consumer goods have reduced rates in Europe. Special treatment alleviating the bookkeeping for timber growers is also applied in many countries. This

treatment was adopted after the VAT was already in place in the EEC. To date, no such treatment has been suggested in the United States. Meanwhile, American economists have suggested either a reduced rate or normal exemption for residential real property and other necessary goods.

A firm's administrative burden from the VAT varies depending on its level in the production chain, the size and sophistication of the company, the tax rate and the number of rates, the invoice format, the remittance procedure, and the sales method (cash or credit). The administrative burden on private forestry would differ depending on the same criteria. Forestry has the full range of entrepreneurs, integrated and nonintegrated firms, large and small operations, corporate and private firms, even individual land holders.

When the consumption type VAT is applied uniformly, the tax is neutral with respect to consumer choices, labor intensity, production efficiency and debt financing. Many economists consider the VAT regressive (having a greater burden on lower income groups) unless altered in some way for basic necessities. Therefore, a trade-off occurs between regressivity and neutrality.

Most economists agree that for the consumption type VAT, calculated using the invoice method, most of the tax is

shifted forward. When substituted for another tax, price effects can be minimal to none; but if the tax is added on or results in higher aggregate tax revenues, consumer product prices are expected to rise by the full amount of the tax in the first round. Several economists note that the shift depends on the elasticities of supply and demand which is the subject of this investigation.

Little empirical work has been done on VAT impacts. Past studies deal mainly with national price effects and inflation. Aaron (1968) examined price effects, industry by industry, using the GNP type VAT. However, our study is concerned with effects of new residential housing price-changes on the landowner or timberowner's expected prices.

Using three stage least squares and analytically derived reduced form estimates in a three equation recursive model, the short-run analysis yielded housing price elasticities of new housing demand quantity, of southern pine sawtimber stumpage price, and of southern pine sawtimber supply quantity. Short-run supply of new housing is considered perfectly elastic in this model. Point elasticities for each of the above variables are derived using 1982 and average data. The price elasticity of housing square foot consumption is -.901 percent for 1982 and -.848 percent over the average of the data. Thus, for 1982, a one percent

increase in housing price would lead to an estimated .9 percent decrease in square footage of new housing consumed. In the stumpage demand equation, housing price elasticity of stumpage price net of VAT is -.071 percent for 1982 and -.083 over the average. Similarly, the housing price elasticity of stumpage supply is -.004 percent for 1982 and -.008 percent over the average.

To measure the price-changes at the stumpage level, percent housing price-increases are set equal to different VAT rates. The individual landowner can determine short-run gross revenue using the rate proposed to find expected stumpage price-changes, e.g. (VAT rate)(housing price elasticity of stumpage price) = expected percentage stumpage price-change. Specifically, a five percent VAT yields a short-run change of

$$(5\%)(-.071\%) = -.355\%$$

in the southern pine sawtimber stumpage price. The percent changes in stumpage quantity are for the South overall. In a competitive market, each individual would be able to sell as much timber as he wanted at the given price. Thus, expected price multiplied by quantity equals the new stumpage revenue for southern pine sawtimber owners. Although these estimates appear to be precise quantities, they should only be viewed as general directional

indicators, i.e. we could expect a relatively small decrease in stumpage price.

Therefore, this model implicitly depicts a shift in the demand function for southern pine sawtimber stumpage due to a price change for new single-family housing in the short run. The shift is small compared to the increase in housing prices due to the VAT. Because this model depicts the very short-run, the housing market remains in disequilibrium with an excess supply (see Fig. 2e).

It is difficult to speculate on the long-run effects of a VAT-induced housing price change on stumpage. Perfect elasticity assumed for the short-run housing supply curve is not expected to be maintained in the long-run, instead an upward sloping housing supply curve is expected. After housing prices are first increased by the VAT, suppliers with a surplus quantity will reduce their prices. Some suppliers operating at the margin may then drop out of housing production, resulting in a leftward shift of the long-run supply curve (see Figure 1a). The resulting change in the quantity of housing sold is less than in the short-run case modeled. Therefore, the effect on stumpage prices, supply quantity, and revenues could be even less in the long-run.

On the other hand, the model is based on a price increase in the housing market alone. A VAT on all consumption products and services, may depress new housing consumption further. This could decrease equilibrium price and quantity for stumpage more than estimated here.

Additionally, in the very long-run, technology may change and with it the traditional forms of housing. A VAT-induced price increase may stimulate a technology change leading to lower production costs for single family houses. This would shift the supply curve to the right and result in lower housing prices and a greater quantity sold. As the demand quantity of new housing increases, stumpage prices and quantities could rise.

Based on the short-run analysis of the new housing market alone, one can speculate that a VAT in the neighborhood of 5 percent would result in an after-tax southern pine stumpage price reduction of about -.355 percent. For a timber grower, such a small change in price would have little to no effect upon investment patterns and rotation length. The magnitude of the price-change compared to risks involved in forestry suggests that investment patterns would not be substantially altered by the imposition of the VAT. As for harvest age, Broderick, et al. (1982) state that a substantial increase in product prices brought no change in

optimal loblolly pine rotation, since the forest value growth percent was changed little, when given stable prices at rotation age.

Precise VAT impacts on land use patterns are indeterminate, but are not likely to be substantial, at least not in the short-run, at the low VAT rates commonly considered in the United States. Land use is dictated by relative bid prices which various enterprises can make for land (i.e. net present value of future income). Based on the short-run results of this study, one would expect that a VAT would slightly reduce bid prices for forest land. Similarly, a universal VAT would also tend to reduce bid prices generated by competing uses such as agriculture, thus having little impact on relative bids. What is currently highest and best use on a given tract is likely to remain so after imposing a VAT. More detailed predictions would require a more complete analysis than was presented here.

Future Research

Although the model's conclusions are restricted, it can lead to further empirical research on VAT impacts. First, the scope of the model was scaled down from all of forestry to the market for southern pine sawtimber in housing. Further research could expand this to all species in all

possible forest products. In addition, price-changes for housing alone are modeled. If VAT-induced price-increases for all consumer products were considered, stumpage consumption could be further depressed.

These limitations are due partly to inadequate data. Future research would be enhanced if a larger data series were available. Another limitation of the data series is information concerning the square footage cost of construction. With this information, the model could incorporate a reduced rate or an exemption for residential housing.

The imposition of the VAT is limited to an add on tax in this model. In further research, provision could be made for the substitution of the VAT for another tax such as corporate income, or social security taxes. In addition, the benefits of the tax revenue is omitted here. Further research could detail possible expenditures by the governmet and how they might effect forestry.

To quantify the impacts of a VAT on rotation length, investment patterns, long term wood output, intensity of management , and forestry employment, a long-run model must be specified. Each structural equation needs dynamic elements, e.g. lagged variables (Heien 1980), and the assumption of perfect elasticity in short-run supply must be

relaxed. The logical extension of research is to develop a dynamic model incorporating multiple market levels and all possible substitutes and complements. Such a model could determine long-range impacts, simulate a multiple rated VAT, determine effects of varying price changes in substitute and complementary goods, and incorporate all possible uses of stumpage.

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Appendix A

VARIABLE LIST

List of Variable Definitions

SQFTSOL1 = Average square footage per house sold.
YEAR = Year; trend variable.
YEARSQR = Year squared.
D = Qualitative variable.
SOLD1 = Number of new single-family houses sold (thousands).
STARTS = Number of private farm and non-frm units started (thousands).
PRICE1 = Sale price of new single-family houses (dollars).
VALUE = Value of private new housing units put in place (billions of dollars).
MORTGAG1 = Mortgage interest rates (percent).
MOODY = Moody Aaa corporate bond ilnterest rates (percent).
HS = Quantity of new single-family houses sold (square feet).
PRSQFT = Price of houses sold (dollars/square foot).
CAPINC = Per capita disposable income (dollars/person).
MORT = Mortgage interest rates with extrapolation (percent).
VAC = Year round vacancy rate (percent).
RENT = Rent portion of consumer price index.
SPPRIC = Price of southern pine sawtimber (Louisiana stumpage in dollars/MBF).
DFPRIC = Price of Douglas-fir sawtimber stumpage (dollars/MBF).
LUMPRIC = Price index of southern pine lumber.
REMOVAL = Southern pine sawtimber stumpage harvested (MBF).
PULPPRIC = Price of southern pine pulpwood (Louisiana stumpage in dollars/cord).
INVENT = Inventory of stnding southern pine sawtimber (MBF).

Appendix B

DATA

Table B1

Stumpage Data[1]

YEAR	REMOVAL[2]	SPPRIC[3]	PULPRIC[3]	INVENT[2]	DFPRIC[4]	LUMPRIC[5]
1955	9383608	39.1272	4.30175	145688740	36.035	117.456
1956	9095757	40.5283	4.72973	145941250	46.314	119.779
1957	8807906	36.6548	5.04152	146193750	31.079	111.151
1958	8520055	35.1848	4.90762	146446260	25.173	106.582
1959	8232204	36.7468	4.86827	146698760	42.153	109.278
1960	7944353	34.0248	4.96054	146951270	36.077	105.862
1961	7656502	31.1161	4.74330	147203770	30.804	100.335
1962	7368651	31.3245	4.69095	147456280	27.373	99.117
1963	8100272	29.5311	4.68920	156281390	30.425	97.601
1964	8831894	29.0850	4.62863	165106510	41.012	96.448
1965	9563515	30.0529	4.65608	173931620	45.079	96.508
1966	10295136	35.2366	4.68107	182756730	51.440	103.086
1967	11026757	36.8000	4.60000	191581850	41.700	100.000
1968	11758379	39.1075	4.46257	200406960	58.733	109.117
1969	12490000	45.7013	4.23497	209232080	74.863	114.754
1970	13221621	39.9140	4.04127	218057190	36.028	98.624
1971	13724108	46.1665	3.91591	225435550	40.396	110.552
1972	14226595	52.9290	3.79090	232813900	57.223	120.910
1973	14729082	63.2607	3.90684	240192260	103.757	141.172
1974	15231568	61.5572	4.09614	247570620	137.035	124.915
1975	15734055	50.6079	3.97022	254948980	105.149	108.747
1976	16236542	59.2962	3.92962	262327330	103.343	127.507
1977	16739029	66.0716	3.91185	269705690	124.463	144.628
1978	17241516	79.9386	3.99181	277084050	128.096	155.885
1979	17744003	97.0929	4.27783	284462400	181.417	149.126
1980	18246490	76.6532	4.17342	291840760	175.122	120.502
1981	18748976	67.9038	4.64023	299219120	128.561	107.048
1982	19251463	50.0000	4.95330	306597480	40.886	98.686

[1] The most current data is obtained through direct contact with the sources mentioned for many of the following variables.

[2] Source: USFS 1982, 1973, 1965, 1958 extrapolated and interpolated.

[3] Source: Ulrich 1981, Hair and Ulrich 1969, and Louisiana State Department of Marketing.

[4] Source: Ulrich 1981.

[5] Source: U. S. Bureau of Labor Statistics (various issues).

Table B2

Housing Data

YEAR	HS[1]	PRSQFT[1]	CAPINC[2]	MORT[2]	VAC[3]	RENT[2]	CPI[2]
1955	387707	37.4239	2074.81	5.10698	6.2	105.112	80.2
1956	383886	34.5382	2138.82	5.38378	6.2	105.528	81.4
1957	397186	30.4219	2137.60	5.79917	6.2	103.796	84.3
1958	473462	25.2274	2115.47	5.53487	6.7	102.887	86.6
1959	622249	22.0678	2189.00	6.13608	7.0	103.551	87.3
1960	580453	21.8067	2195.04	6.07159	7.4	103.382	88.7
1961	636437	19.4023	2222.10	5.94665	7.6	103.683	89.6
1962	724624	18.4612	2288.08	5.85993	7.4	103.753	90.6
1963	764400	15.4190	2338.06	6.42312	7.2	103.599	91.7
1964	830550	15.0114	2471.47	6.26480	7.3	103.229	92.9
1965	876875	14.9189	2590.48	6.14815	7.6	102.540	94.5
1966	723770	15.2683	2688.27	6.43004	7.5	101.029	97.2
1967	784070	15.2795	2757.00	6.46000	7.2	100.000	100.0
1968	815850	15.3320	2836.85	6.68906	6.7	98.273	104.2
1969	734720	15.4938	2870.67	7.10383	6.5	96.266	109.8
1970	732350	15.1469	2914.88	7.26569	6.3	94.669	116.3
1971	1033200	14.8131	2984.34	6.38087	6.4	94.971	121.3
1972	1141620	15.3092	3080.61	6.06544	6.4	95.132	125.3
1973	1029200	16.0673	3241.92	5.98047	6.5	93.388	133.1
1974	836670	15.7708	3159.78	6.03927	6.6	88.422	147.7
1975	903040	15.9198	3148.26	5.58313	6.6	85.174	161.2
1976	1092690	16.4634	3212.32	5.27859	6.4	84.868	170.5
1977	1408680	17.3618	3286.50	4.96970	6.4	84.573	181.5
1978	1421000	18.2775	3388.43	4.89253	6.3	83.930	195.4
1979	1247840	18.7652	3372.13	4.95860	6.9	80.957	217.4
1980	926500	18.2096	3246.35	5.12966	6.8	77.634	246.8
1981	745560	17.8187	3240.46	5.39648	6.8	76.432	272.4
1982	696280	17.1722	3238.33	5.23694	6.9	77.482	289.1

[1] The most current data is obtained through direct contact with the sources mentioned for many of the following variables.

[2] Source: U. S. Bureau of Census 1981a and extrapolated.

[3] Source: CEA 1983 and extrapolated.

[4] Source: U. S. Bureau of Census 1981b, 1975 and extrapolated.

Appendix C

DATA RELATIONSHIPS

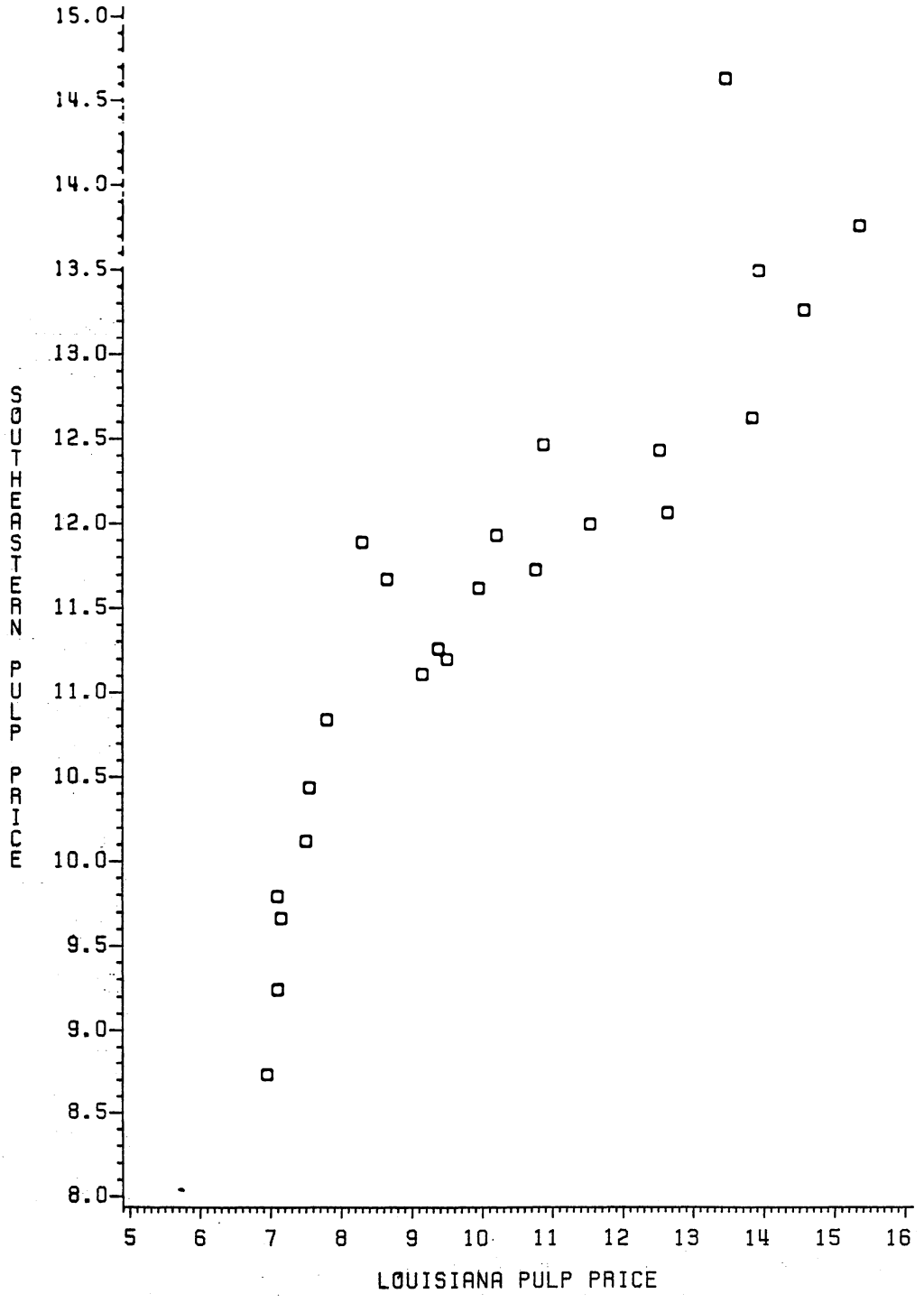

Fig. C1. Southeast/Louisiana Pulpwood Stumpage Relationship.

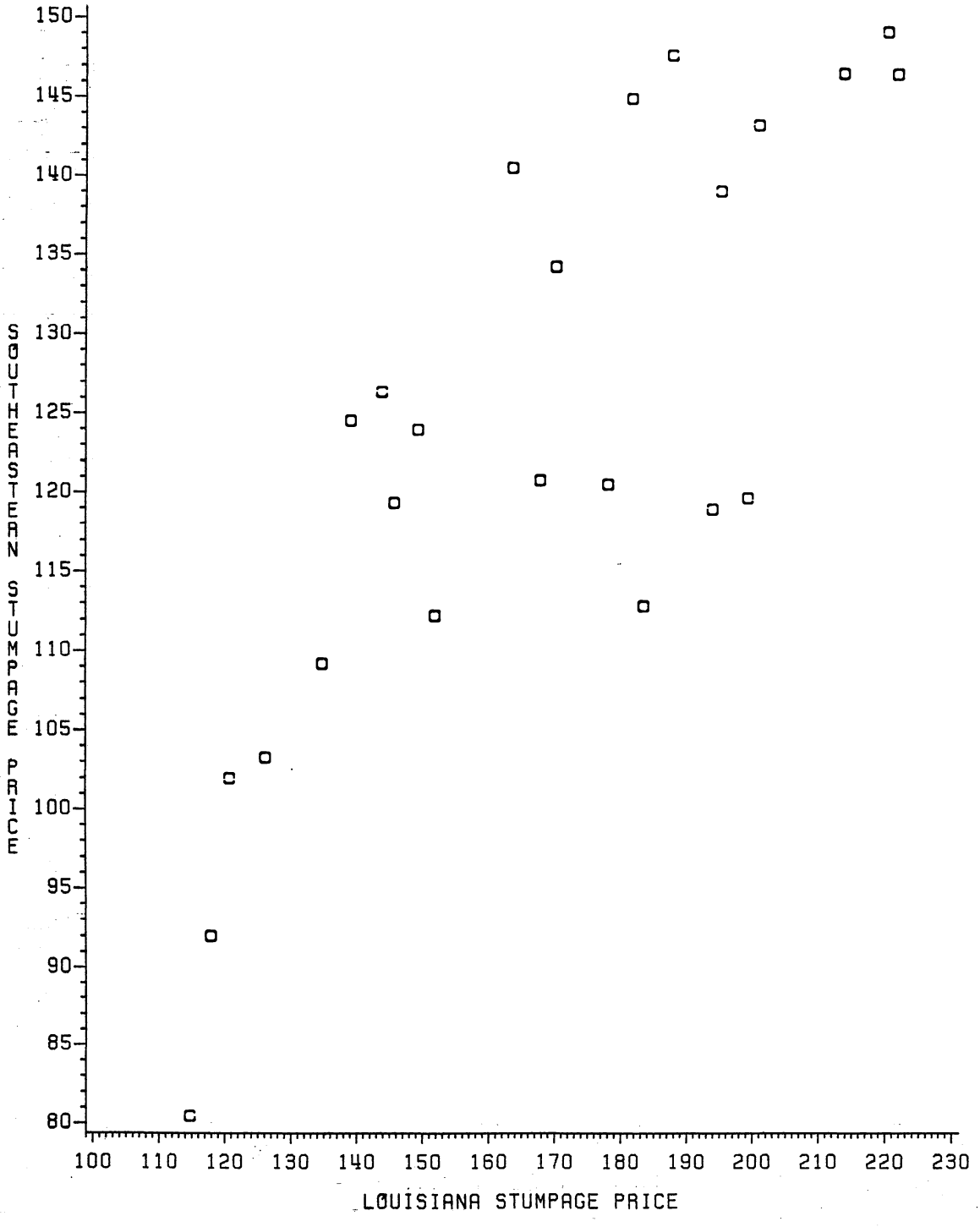

Fig. C2. Southeast/Louisiana Sawtimber Stumpage Relationship.

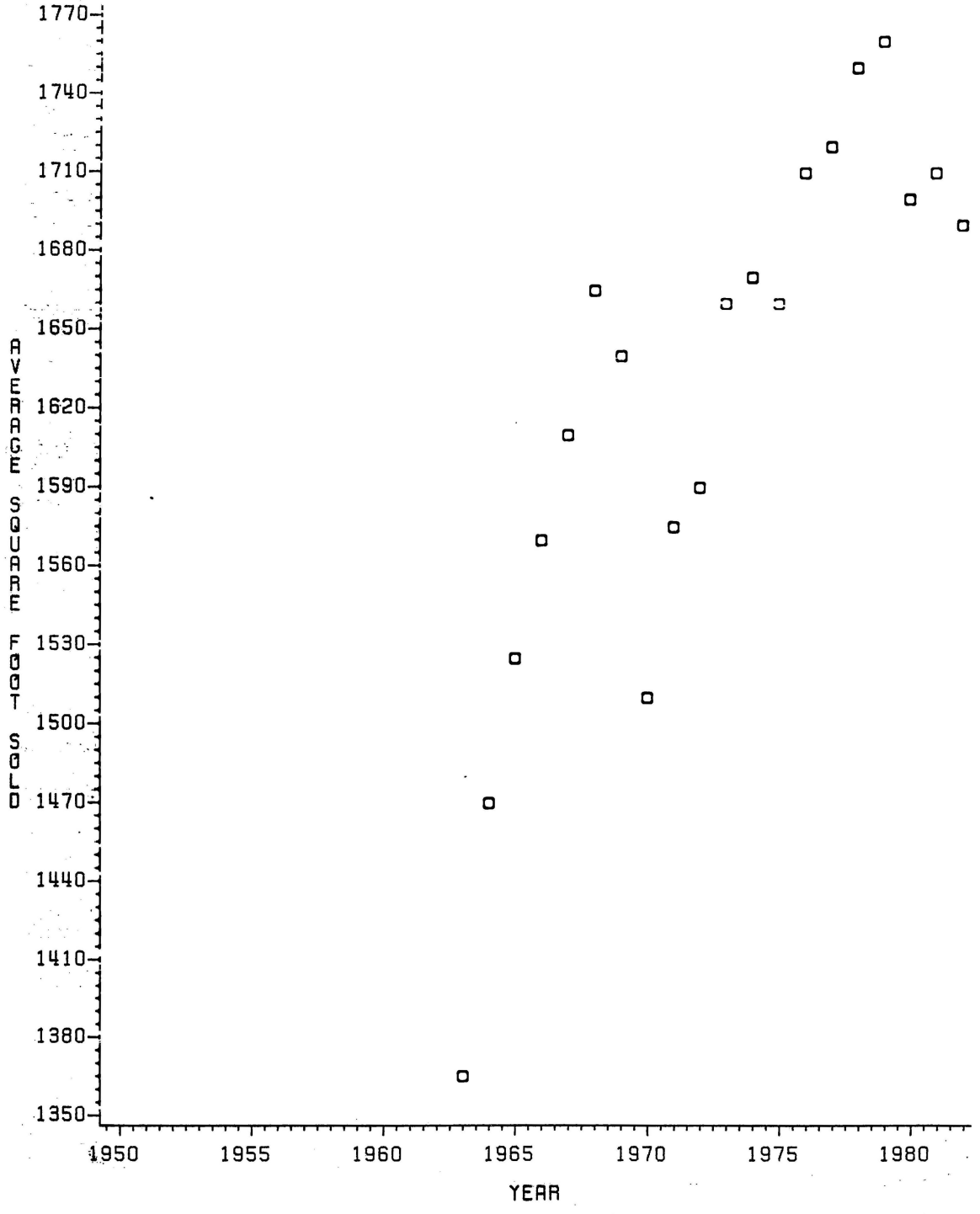

Fig. C3. Square Footage of New Housing/Year.

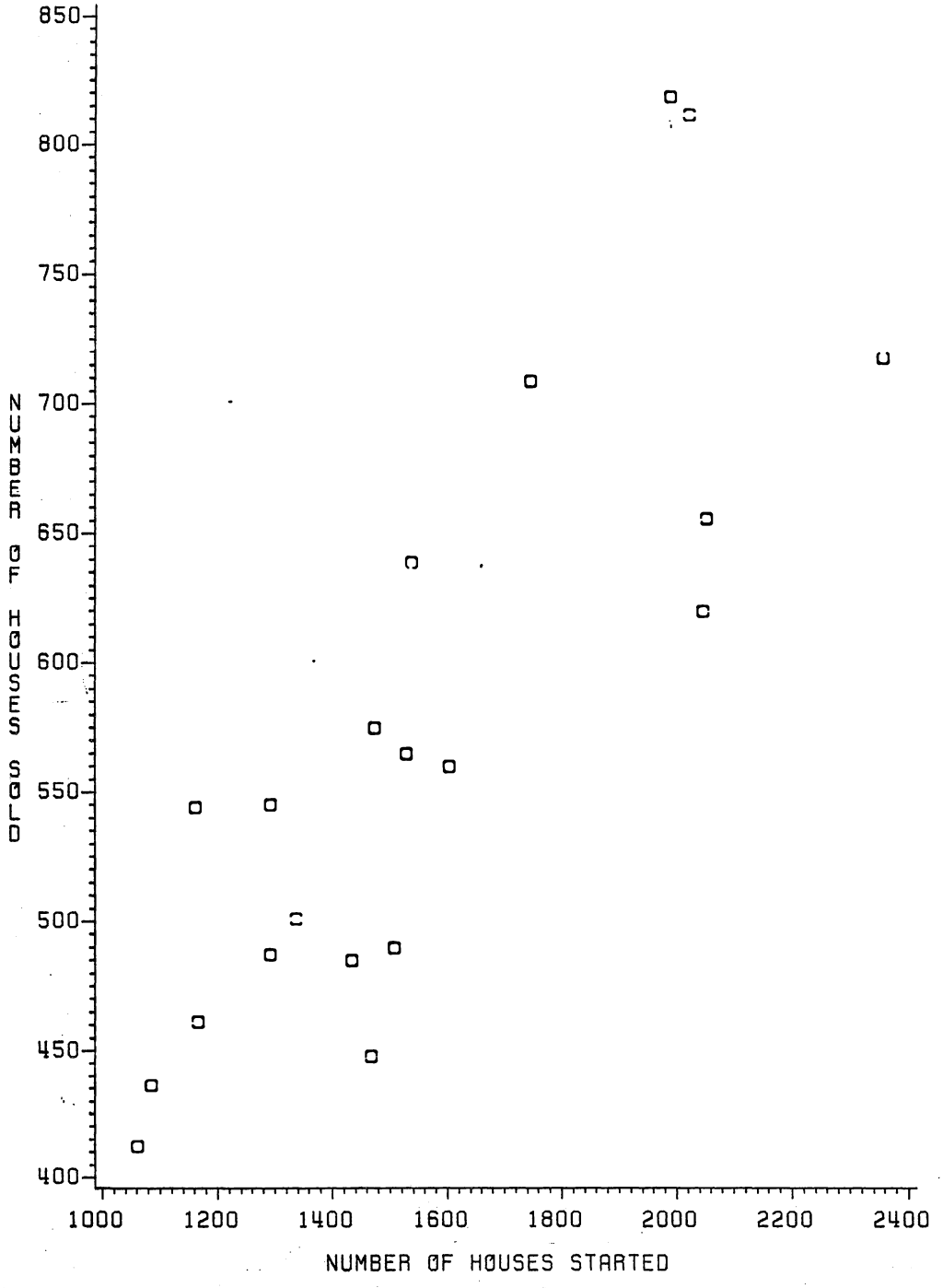

Fig. C4. Sold/Start Relationship.

Appendix D

SUMMARY OF STATISTICS ON DATA

TABLE D.1

Summary of Statistics of Data

VARIABLE	MEAN	STANDARD DEVIATION	MAXIMUM VALUE	MINIMUM VALUE
REMOVAL	12505358.464	3925244.3791	19251463.000	7368651.000
DSPPRIC	47.915	17.5627	97.093	29.085
DPULPRIC	4.421	0.3931	5.042	3.791
INVENT	209361876.786	56126769.9993	306597480.000	145688740.000
DDFPRICE	70.705	46.7796	181.417	25.173
DLUMPRIC	114.121	16.6025	155.885	96.448
HS	819673.882	275166.3053	1421000.000	383886.107
DPRSQFT	19.042	5.9513	37.424	14.813
DCAPINC	2765.287	463.3000	3388.434	2074.813
DMORT	5.876	0.6364	7.266	4.893
VAC	6.786	0.4560	7.600	6.200
DRENT	94.795	9.7106	105.528	76.432

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