A SIMULATION ANALYSIS OF THE EFFECTS OF A PRODUCT TAX ON THE PACKAGING WASTE OUTPUT OF SELECTED FOOD PRODUCTS*

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INTRODUCTION

This country is currently faced with an ever growing solid waste problem. A significant amount of total solid waste may be traced to origins in the packaging industry. Various policies aimed at rectifying this problem have been proposed. One policy alternative that is currently being given consideration is taxation of a product based upon the amount and type of packaging waste associated with that product [3, 4]. Taxation is believed to be a policy tool that could be used to internalize the cost of collection and disposal of each product's packaging waste. In effect, those that generate solid wastes would pay. The effects of such taxation implementation on various economic phenomena are unknown, but of critical importance to its feasibility.

This analysis concerns itself with only a small portion of the total solid waste problem. Specifically, this analysis concentrates upon those packaging wastes generated by household consumption of selected food products. The objectives of the analysis include: (1) estimation of the quantities and composition of packaging waste generated by household consumption of the selected food products before taxation, (2) the determination of tax rates necessary to internalize selected levels of collection and disposal costs associated with each product's packaging waste, (3) simulation of the impact of the exogenous tax on prices and quantities of the selected products, and (4) estimation of changes in quantities and composition of packaging waste generated by the selected products after the tax is implemented.

MODEL

This analysis is couched within a neoclassical theoretical framework. Concepts from consumer demand, tax incidence, and externality theory provide a feasible framework within which to proceed with an empirical analysis. Externality theory provided a motive for the taxation scheme. It is believed that packaging is a source of external diseconomies. This implies a divergence between marginal private cost and marginal social cost. Theoretically, this divergency may be corrected by a product tax. The theory of tax incidence provided a priori hypothesis as to the relative distribution of the tax between producers and consumers. Let us assume that the tax will be levied on the final seller of the product. This assumption will greatly simplify the analysis but should not be misconstrued as the most efficient level at which to levy a tax. Furthermore, we shall assume that a firm in a competitive industry faces a given demand schedule and a given cost structure. Now, suppose that all firms in the industry are taxed at a rate of "t" dollars per unit of output.

The total cost of the i^{th} firm may then be represented by:

$$C_i = f(q_i) + t\,q_i$$

where,

C_i = total variable costs,
$f(q_i)$ = variable production costs, and
tq_i = variable tax costs.

The first order condition for profit maximization requires the firm to equate marginal cost to price:

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$f'(q_i) + t = p$

$f'(q_i) = p - t.$

The firm equates the marginal cost of production plus the unit tax to the market price. The second order condition for profit maximization requires that the marginal cost be rising which we will hereafter assume. We may then obtain the firm's supply function by solving for q_i and setting $q_i = S_i$ for all prices greater than minimum average variable cost:

$S_i = S_i(p - t).$

An aggregate supply function for the industry is obtained by making the usual aggregation assumptions and then summing the individual supply functions:

$$S = \sum_{i=1}^{m} S_i(p-t) = S(p-t).$$

We readily see that industry supply is a function of the net price, $p - t$. This is equivalent to a vertical shift upward of the supply curve. Firms are now willing to supply less than before at every market price. To determine the equilibrium price-quantity combinations, we merely set demand equal to supply:

$D(p) - S(p - t) = 0$

and then solve for p. This is graphically illustrated in Figure 1. Imposition of the tax ($t = E_1 A$) resulted in a new aggregate supply function, S′. The new equilibrium price, P_{E_2}, is determined by the intersection of D = S′. Observation will readily reveal that the price increase is less than the magnitude of the tax ($P_{E_2} - P_{E_1} < P_{E_2} - P_2$). A portion of the tax is absorbed by the firm and the remainder is shifted to the consumer. These relative portions are subject to tax incidence theory. An accurate estimation of the incidence of any tax is of critical importance to the political palatability of the tax and it is to this issue we now turn.

Assume the aggregate supply function of product "x" is of the form f(x) with $f'(x) > 0$. The aggregate demand for product x is of the form g(x) with $g'(x) < 0$. The per unit tax rate "t" is a constant and is paid by the supplier of good x. The before-tax equilibrium may be represented by:

$f(x) = g(x)$

and x_1 the before-tax equilibrium quantity. The after-tax equilibrium may be represented by:

$f(x_1, t) = g(x_2)$

where x_2 is the after-tax equilibrium quantity. The price the buyers have to pay after imposition of the tax is:

$P_{E_2} = g(x_2).$

The buyers' share of the tax burden is given by:

$P_{E_2} - P_{E_1} = g(x_2) - g(x_1).$

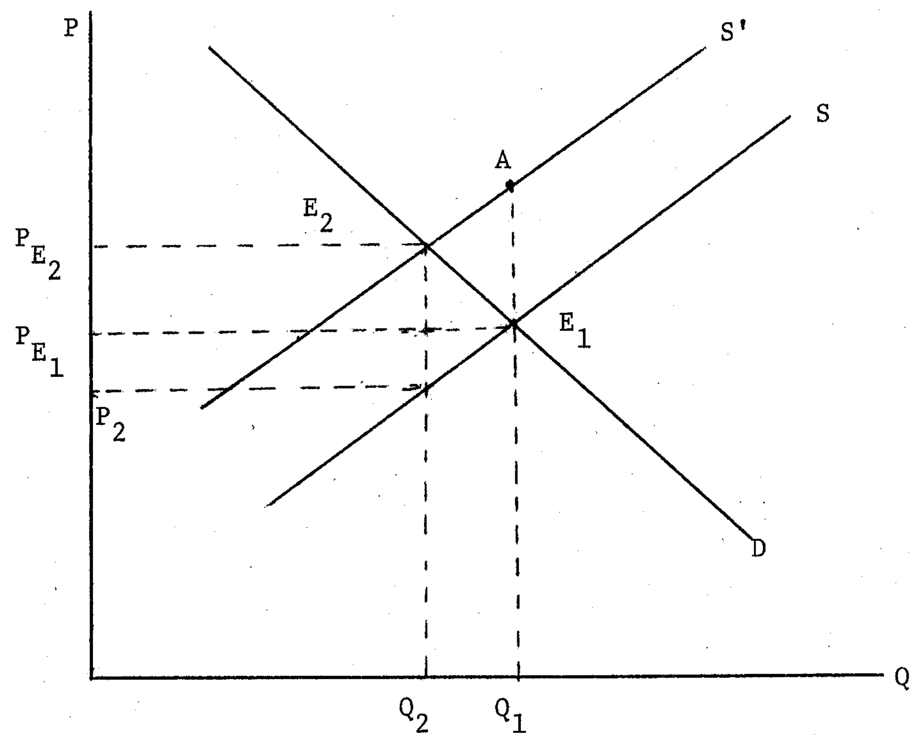

Figure 1. THE EFFECT OF A UNIT TAX ON EQUILIBRIUM.

After payment of the tax, the suppliers' unit revenue may be represented by

$$P_2 = f(x_2) = f(x_1, t).$$

The suppliers' share of the tax burden is given by:

$$P_{E_1} - P_2 = f(x_1) - f(x_2).$$

The distribution (ratio) of the tax burden between suppliers and buyers will be given by:

$$D = \frac{f(x_1) - f(x_2)}{g(x_2) - g(x_1)} = \frac{\text{Producer's share}}{\text{Consumer's share}}.$$

If we assume linear functions and "small" taxes such that $\lim_{t \to 0} (x_2 - x_1) \to 0$

we see that:

$$f(x_2) = f(x_1) + (x_2 - x_1) f'(x_1)$$

$$g(x_2) = g(x_1) + (x_2 - x_1) g'(x_1)$$

and,

$$D = \frac{-(x_2 - x_1) f'(x_1)}{(x_2 - x_1) g'(x_1)} = -\frac{f'(x_1)}{g'(x_1)} = \frac{\text{Producer's share}}{\text{Consumer's share}}.$$

To estimate the incidence of the tax under consideration $f'(x_1)$ and $g'(x_1)$, the slopes of the supply and demand functions evaluated at point x_1 must be known. These values may be derived, given elasticities and equilibrium quantity by the following procedure. Let:

$$\epsilon_d = \frac{\partial Q}{\partial P} \cdot \frac{P}{Q}$$

ΔP = "small" change in P, and

ΔQ = change in Q.

Then,

$$g'(x_1) = \frac{\Delta P}{\Delta Q}.$$

And as $\Delta P \to 0$, we know that

$$g'(x_1) = \frac{P}{Q} = \frac{1}{Q/P}.$$

Therefore, substituting this into the elasticity formula:

$$\epsilon_d = \frac{1}{g'(x_1)} \cdot \frac{P}{Q}.$$

And then solving for $g'(x_1)$:

$$g'(x_1) = \frac{P}{\epsilon_d \cdot Q}$$

where $g'(x_1)$ is a derived estimate of the slope of the demand curve at a particular equilibrium point. The same derivation procedure may also be used to estimate the slope of the supply curve, $f'(x_1)$.

Having estimates of both demand and supply slopes, we now have sufficient knowledge to estimate the incidence of the tax. Remember that the distribution (D) of the tax is:

$$D = \frac{f'(x_1)}{g'(x_1)} = \frac{P/(\epsilon_s \cdot Q)}{P/(\epsilon_d \cdot Q)} = \frac{\epsilon_d}{\epsilon_s}.$$

Knowing the ratio and the magnitude of the tax (t), we may convert the ratio into the percent of the tax that is shared by both producer and consumer by:

$$\%\text{ to producer} = \frac{f'(x_1)}{f'(x_1) + g'(x_1)},$$

$$\%\text{ to consumer} = \frac{g'(x_1)}{f'(x_1) + g'(x_1)}.$$

To estimate the absolute change in market price, we multiply the percentage of the tax borne by the consumer by the amount of the tax:

$$\Delta P = \left[\frac{g'(x_1)}{g'(x_1) + f'(x_1)}\right] \cdot t.$$

The after-tax equilibrium price (P*) is:

$$P^* = P + \Delta P.$$

We are also in a position to estimate the change in equilibrium quantity as a result of the tax. Let

$$\epsilon_d = \frac{\partial Q}{\partial P} \cdot \frac{P}{Q} = \frac{\%\Delta Q}{\%\Delta P}.$$

Therefore,

$$\%\Delta Q = \epsilon_d \cdot (\%\Delta P).$$

And the absolute change in equilibrium quantity is:

$$\Delta Q = (\%\Delta Q) \cdot Q.$$

The after-tax equilibrium quantity (Q*) will then be:

$$Q^* = Q - \Delta Q.$$

The above specifications were utilized in assessing the impact of a product tax, once the tax is known, upon price and quantity. The calculation of individual product tax rates was a significant portion of the model. They were calculated by the following procedure:

$$T_i = \sum_{i=1}^{m} \frac{a_{ij}}{2000} c_j$$

where,

T_i = Tax rate per pound (net weight) of the i^{th} product,

a_{ij} = Amount of the j^{th} type of packaging waste generated by one unit of the i^{th} product, and

c_j = Cost, per ton to collect and dispose of the j^{th} type packaging waste.

It should be noted that T_i is a type of weighted tax. Its magnitude will depend upon not only the *amount* of each type(s) of packaging used but also the *cost* of collecting and disposing of each type(s) of waste.[1]

[1] In this paper, the cost per ton of waste was considered to be the same for all waste components. In other words, the collection and disposal cost of a ton of plastic was assumed to be the same as a ton of paper, a ton of glass or a ton of metal. In the study on which this paper is based [6] this assumption was relaxed, i.e., collection and disposal costs were assumed to differ among waste components.

Another component of the model deals with the estimation of annual quantity and composition of waste generated by the selected products. The technique is based on the assumption that output (packaging waste) may be calculated given knowledge about the quantity of inputs (selected products). Let,

n = number of products

m = number of waste types

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1m} \\ a_{21} & a_{22} & \cdots & a_{2m} \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ a_{n1} & a_{n2} & \cdots & a_{nm} \end{bmatrix}$$

$$Q = \begin{bmatrix} Q_1 \\ Q_2 \\ \cdot \\ \cdot \\ \cdot \\ Q_n \end{bmatrix}$$

Matrix A is the input-output coefficient matrix, where:

a_{ij} = amount of the j^{th} type of packaging waste generated by one unit of the i^{th} product. The input-output coefficients were derived by experimentally determining the amount of each type of packaging waste associated with each of the selected food products. The individual coefficients were calculated by selecting ten items of the product at random from a selected grocer's shelf and obtaining the mean weights of the various packaging wastes using finely calibrated scales. Where necessary, products were disassembled to obtain the weight of each waste component. The input-output coefficients were then obtained by dividing the weight of each of the solid waste components by the net weight of the contents of the package.

Matrix Q is the consumption matrix, where:

Q_i = annual per capita consumption, in pounds of the i^{th} product before tax. This data were obtained from the George and King study [2].

In addition, let:

P = population,

TW_j = total quantity of the j^{th} waste generated by n products,

TW_i = total quantity of m types of waste generated by i^{th} product, and

GTW = total of m wastes generated by n products.

Therefore,

$$TW_j = P \sum_{i=1}^{n} a_{ij} Q_i,$$

$$TW_i = P \sum_{j=1}^{m} a_{ij} Q_i, \text{ and}$$

$$GTW = P \sum_{i=1}^{n} \sum_{j=1}^{m} a_{ij} Q_i$$

The exogenous tax ultimately results in a new equilibrium in which both prices and quantities are variable. The decreased quantity of the taxed good will reduce the amount of packaging waste generated due to an actual reduction in the total quantity of that good that enters households. It is this change in waste attributable only to consumer response via decreased consumption that is being focused upon in this study. An implicit but critical assumption is that producers will not respond to the taxation by altering their packaging technology. This assumption is made, being cognizant that it may be counter to the neoclassical theory of factor substitution. The assumption adds simplicity to the analysis and is believed to not distort actual producer reaction to any significant degree. A preliminary analysis revealed that the per unit tax rates and accompanying changes due to the tax were rather "small." Therefore, it is believed that the producer will not alter his fixed packaging technology in response to such small price perturbation. To obtain the after-tax quantities of waste, we utilize the A matrix and the after tax quantities of products. To do this we merely substitute the annual per capita consumption of the i^{th} consumer after-tax (Q_i^*) into the above summation formulas and recompute the totals.

In translating the theoretical concepts into operational empirical procedures alternative assumptions regarding elasticities of supply were made because of a lack of information about the magnitudes of these parameters. Specifically, alternative assumptions were made with regard to each product's price elasticity of supply and cost of collection and disposal of wastes.[2] The effect of these

[2] In this paper, the direct price elasticity of supply was assumed to be unitary, +1.0, and the cost of collection and disposal was set at two levels, $20 and $50 per ton. In the original study [6] these assumptions were relaxed. Elasticity of supply was allowed to vary from +.4 to +1.4 in increments of 0.2. Collection and disposal costs were allowed to vary from $10 per ton to $60 per ton in increments of $10.

alternative assumptions were simulated by employing a deterministic simulation model. The model consisted of the empirical procedures which were derived from the theoretical concepts previously outlined in this analysis.

EMPIRICAL RESULTS

Only a partial set of the empirical results yielded by the simulator are presented. Those presented are intended to demonstrate the feasibility of using a simulation approach in the problem at hand. The first set of results are those that describe the quantity and composition of packaging waste generated by the selected group of commodities. These results were derived by utilizing the waste input-output coefficients, per capita consumption of the selected products, and U.S. population total. The coefficients were experimentally determined in August 1972 [6]. Per capita consumption data for the selected products were taken from the George and King study [2] and are applicable to 1968 comsumption patterns. More recent reliable per capita data was not available. The August 1972 U.S. population total was used as estimated by the Census Bureau [5]. These results are presented in Tables 1 and 2. Table 1 gives us a great deal of insight into the relative amounts of packaging waste generated by the forty-four selected products. The results reveal that fresh fruits and vegetables contribute relatively small amounts of packaging waste. But cereals, beef, salad dressing and fresh milk each contributed over one *billion* annually. Fresh milk contributed almost four billion pounds. A bit of reflection on these results confirms their feasibility.

Table 2 contains the estimates of total pounds of each waste type and the aggregate packaging generated by annual consumption of these products. As explained in Table 2 the paper component of waste is over nine and one-half *billion* pounds annually. It is the single most important component in terms of quantity. Its relative importance is not surprising since paper is used extensively in almost all

Table 1. ANNUAL PACKAGING WASTE GENERATED BY ANNUAL U.S. CONSUMPTION OF SELECTED PRODUCTS, BEFORE TAXATION.*

Products	Pounds	Product	Pounds
Fresh sweet potatoes	1,793,949	Shortening	184,205,303
Fresh beans	7,508,806	Ice cream	204,719,705
Fresh carrots	8,486,347	Corn meal	207,127,035
Fresh onions	10,280,297	Wheat flour	222,668,867
Fresh tomatoes	17,794,474	Cheese	234,771,043
Dry vegetables	18,111,369	Frozen vegetables	303,574,911
Lettuce	21,221,240	Canned tomatoes	407,890,383
Fresh apples	22,526,419	Evaporated milk	481,672,192
Fresh oranges	23,342,827	Fish	493,738,919
Fresh bananas	23,670,464	Canned peas	507,283,774
Frozen fruits	30,008,369	Canned peaches	534,278,953
Veal	32,890,505	Chicken	538,903,475
Dried fruits	33,525,369	Corn syrup	549,866,977
Lamb	37,618,737	Canned corn	595,585,831
Rice	44,523,246	Soup	607,662,226
Turkey	52,104,025	Eggs	684,803,124
Fresh potatoes	76,892,753	Coffee	703,033,732
Butter	84,983,788	Pork	740,510,087
Sugar	121,722,153	Breakfast cereals	1,079,540,743
Canned pineapple	134,932,925	Beef	1,116,923,641
Lard	146,873,368	Salad dressings	1,947,412,645
Margarine	161,908,768	Fresh milk	3,983,873,529
		TOTAL	17,324,240,294

*Per capita annual consumption data were taken from George and King [2]. The August 1972 population estimate of the Census Department was used [5]. Waste coefficients were experimentally determined [6].

Table 2. POUNDS OF PACKAGING WASTE GENERATED BY ANNUAL U.S. CONSUMPTION OF FORTY-FOUR SELECTED COMMODITIES, BEFORE TAXATION.*

Waste Type	Pounds
Paper	9,668,000,000
Glass	535,000,000
Metal	4,262,000,000
Plastic	2,858,000,000
TOTAL	17,323,000,000

*Per capita annual consumption data were taken from George and King [2]. The August 1972 population estimate of the Census Department was used [5]. Waste coefficients were experimentally determined [6].

products to some degree. The total pounds of all packaging waste generated by the selected products is over seventeen billion pounds. If we assume the usual average density of this waste to be 520 pounds per cubic yard, the packaging waste generated annually by the selected products would fill 110,340,000 seventy-ton hopper rail cars.

The empirical results in Table 3 show the product tax rate (T_i's) necessary to internalize the costs of collection and disposal of each product's packaging waste. It must be recalled that individual tax rates are a function of the costs of collecting and disposing of each waste type. The results presented in Table 3 are based on the following assumptions: 1. There is no difference in costs to collect and dispose of different waste types, and 2. two alternative levels of costs of collection and disposal, $20 and $50 per ton. Table 3 reveals that these costs could be internalized with a tax of generally much less than one cent per pound. However, since the tax is also

Table 3. TAX RATE IN CENTS PER POUND NET WEIGHT NECESSARY TO INTERNALIZE TWO ALTERNATIVE COST LEVELS.

Product	Cost Levels		Product	Cost Levels	
	$20/Ton	$50/Ton		$20/Ton	$50/Ton
	cents per pound			cents per pound	
1. Beef	.0630	.1575	23. Bananas	.0050	.0125
2. Veal	.0630	.1575	24. Oranges	.0050	.0125
3. Pork	.0630	.1575	25. Canned Peaches	.3720	.9300
4. Lamb	.0630	.1575	26. Canned Pineapple	.3180	.7950
5. Chicken	.0630	.1575	27. Dried Fruits	.1030	.2575
6. Turkey	.0940	.2350	28. Frozen Fruit	.1850	.4625
7. Fish	.1250	.3125	29. Lettuce	.0050	.0125
8. Eggs	.1140	.2850	30. Tomatoes	.0050	.0125
9. Butter	.0620	.1550	31. Beans	.0050	.0125
10. Lard	.1660	.4150	32. Onions	.0050	.0125
11. Shortening	.1660	.4150	33. Carrots	.0050	.0125
12. Margarine	.0620	.1550	34. Canned peas	.3790	.9475
13. Salad dressing	1.1260	2.8150	35. Canned corn	.3650	.9125
14. Fresh milk	.1340	.3350	36. Canned tomatoes	.2840	.7100
15. Evaporated milk	.2380	.5950	37. Dry vegetables	.0150	.0375
16. Cheese	.0620	.1550	38. Frozen vegetables	.1500	.3750
17. Ice cream	.0550	.1375	39. Rice	.0310	.0775
18. Potatoes	.0050	.0125	40. Wheat flour	.0440	.1100
19. Sweet potatoes	.0050	.0125	41. Breakfast cereals	.2910	.7275
20. Sugar	.0160	.0440	42. Corn meal	.1040	.2600
21. Corn syrup	1.1250	2.8125	43. Coffee	.3120	.7800
22. Apples	.0050	.0125	44. Soup	.2190	.5475

Table 4. PERCENTAGE CHANGE IN PRICE AND QUANTITY AS A RESULT OF THE PRODUCT TAX, ASSUMING TWO ALTERNATIVE COST LEVELS, AND PRICE ELASTICITY OF SUPPLY EQUAL TO 1.0.

Commodity	$20 per ton level		$50 per ton level	
	Percentage Increase in Price	Percentage Decrease in Quantity	Percentage Increase in Price	Percentage Decrease in Quantity
1. Beef	.000562	.03620	.001406	.09050
2. Veal	.000276	.04747	.000691	.11869
3. Pork	.000724	.02991	.001810	.07477
4. Lamb	.000237	.06227	.000593	.15566
5. Chicken	.001022	.07947	.002556	.19866
6. Turkey	.000773	.12027	.001933	.30069
7. Fish	.001739	.03999	.004347	.09997
8. Eggs	.001951	.06209	.004877	.15522
9. Butter	.000562	.03669	.001406	.09172
10. Lard	.006474	.25897	.016186	.64743
11. Shortening	.003396	.34500	.008491	.86250
12. Margarine	.001265	.10704	.003161	.26760
13. Salad dressing	.019901	1.38194	.049753	3.45486
14. Fresh milk	.004431	.15311	.011078	.38278
15. Evaporated milk	.011657	.37281	.029144	.93203
16. Cheese	.000839	.03859	.002097	.09647
17. Ice cream	.000990	.05223	.002475	.13058
18. Potatoes	.000382	.01180	.000956	.02950
19. Sweet Potatoes	.000192	.00998	.000480	.02496
20. Sugar	.001109	.02682	.002772	.06704
21. Corn Syrup	.041086	1.81969	.102715	4.54923
22. Apples	.000196	.01412	.000490	.03529
23. Bananas	.000240	.01474	.000599	.03686
24. Oranges	.000256	.01698	.000640	.04244
25. Canned peaches	.011142	.84585	.027855	2.11462
26. Canned pineapple	.006123	.50586	.015307	1.26464
27. Dried fruit	.001665	.10914	.004164	.27285
28. Frozen fruits	.002523	.25227	.006307	.63068
29. Lettuce	.000215	.00305	.000539	.00762
30. Tomatoes	.000134	.00515	.000334	.01286
31. Beans	.000172	.00440	.000431	.01099
32. Onions	.000326	.00815	.000815	.02038
33. Carrots	.000230	.01143	.000575	.02857
34. Canned peas	.014960	.27676	.037400	.69191
35. Canned corn	.013683	.34892	.034208	.87231
36. Canned tomatoes	.012110	.21316	.030278	.53289
37. Dry vegetables	.000567	.02720	.001416	.06799
38. Frozen vegetables	.025018	2.58788	.062545	6.46970
39. Rice	.001197	.03830	.002992	.09574
40. Wheat flour	.003411	.10233	.008527	.25581
41. Breakfast cereals	.005926	.13036	.014814	.32591
42. Corn meal	.008941	.19670	.022352	.49174
43. Coffee	.002687	.06776	.006719	.16941
44. Soup	.006448	.29017	.016121	.72543

dependent upon the quantity of packaging materials, there are some pronounced exceptions. Products that generate great quantities of packaging waste relative to the amount of edible product, such as salad dressing and corn syrup, are taxed at a higher rate. It should be emphasized that these tax rates account for *only* the cost of collection and disposal of packaging waste. Other waste emanating from the consumption of the products and also any administrative costs associated with the implementation of a taxation program are not considered. Such considerations are beyond the scope of this analysis.

The empirical results in Table 4 reflect changes in equilibrium price and quantity resulting from the previously calculated exogenous tax rates. The direct price elasticity of supply of all products is assumed to be 1.0 for the results presented here [6]. The results indicate that the exogenously imposed tax would not substantially alter prices or quantities. Fisher's Ideal Index was used to reflect price changes. This index was used because it satisfies time, circularity, and factor reversal properties, and also because electronic computers were available to facilitate computations [1]. The index, after taxation, was 100.0022 at the $20 per ton level and 100.5465 at the $50 level. The percentage decrease in aggregate consumption was 0.13328 at the $20 per ton level and 0.33320 at the $50 level.

The decreases in consumption caused by the tax on the packaging waste generated by the selected products are presented in Table 5. A critical assumption is that producers will not alter this packaging technology. Factor substitution theory suggests that producers will reduce the amount of packaging inputs as a result of the taxation. The magnitude of this potential substitution is unknown. Therefore, the assumption made in this analysis results in a conservative (low) estimate of the reduction in waste load. Except for the glass, the results in Table 5 suggest that the waste load would not be changed substantially as a result of the tax.

Table 5. PERCENTAGE DECREASE IN PACKAGING WASTE ATTRIBUTABLE TO PRODUCT TAXATION, ASSUMING TWO ALTERNATIVE COST LEVELS TO BE INTERNALIZED VIA TAXATION.

Waste Type	Percentage Reduction	
	$20/Ton	$50/Ton
Paper	.38	1.11
Glass	1.73	4.55
Metal	.35	.93
Plastic	.04	.12
AGGREGATE	.38	1.00

CONCLUSIONS

The empirical results generated by the simulation model suggest certain policy steps. First, the cost of collection and disposing of product's waste could be internalized via taxation. Such internalization would force those that generate solid wastes to pay. Secondly, the required taxes are relatively small. The small magnitudes of the taxes would cause minor perturbations in equilibrium prices and quantities. Fisher's Ideal Index of price changes was increased to only 100.002191 as a result of the tax based on the $20 assumed cost level. Aggregate consumption was reduced by 0.13 percent. Thirdly, such a taxation scheme would not appreciably alter the total packaging waste load emanating from the taxed products. The aggregate waste load was reduced by only 0.38 percent. If a greater reduction in the waste load is desired, a greater magnitude or another type of tax would be needed. The nature of the specific tax considered in this analysis is regressive in that those that spend a greater portion of their income on the foods considered would pay at a higher rate expressed as a percent of income. The tax may possibly be more useful as a method of financing solid waste management services than it is as a method of altering solid waste loads. However, this possibility needs further analysis.

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