J. ENVIRONMENTAL SYSTEMS, Vol. 12(1), 1982-83

NATIONAL BEVERAGE CONTAINER DEPOSIT LEGISLATION: A COST-BENEFIT ANALYSIS

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ABSTRACT

National beverage container deposit legislation is a viable policy approach to the reduction of the true overall social costs of beverage consumption. Net social benefit would result from the passage of deposit legislation by increasing reuse and recycling of beer and soft drink containers. This study evaluates the interrelated impacts of legislation in terms of employment, natural resource consumption, capital requirements, litter, solid waste, environmental quality, consumer convenience, and prices.

National beverage container deposit legislation is an effective means by which the failure of the market to minimize and internalize the total cost of beverage consumption may be corrected. Through the provision of economic incentives and a bare minimum of government administration, significant reductions in external costs can be achieved with little or no addition to the internal costs of beverage consumption. Hence net social benefits would result from passage of such legislation.

This study evaluates the interrelated impacts of deposit legislation in terms of employment, natural resource consumption, capital requirements, litter, solid waste, environmental quality, consumer convenience, and prices. Separate consideration is given each of the above impact areas. Through the definition of true costs and benefits the feasibility of national deposit legislation is determined.

The purpose of deposit legislation is to induce, through reuse and recycling, conservation of energy and other raw material resources, reduction of litter and the solid waste stream, and reduction of numerous related forms of environmental degradation. This is accomplished by reducing the cost of the containment of beer and soft drinks through the reuse of refillable containers and the recycling of non-refillable containers.

doi: 10.2190/12GJ-3QYL-EGQ7-XMWH
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The deposit system demands a restructuring of the beverage distribution system, encouraging reuse and recycling, and thereby discouraging the production of new containers from raw materials. This reduction in the need to manufacture new containers from scratch reduces the internal and external container production costs per filling. If one bottle is refilled ten times, considerable amounts of raw material resources are saved and related environmental degradation prevented by foregoing the manufacture of nine additional new containers. As consumers are discouraged from discarding empty containers, litter and the solid waste stream are reduced. Above a sufficient return rate of containers, the internal costs of beverages would also be reduced as the decreased container costs outweigh the increased distribution and handling costs.

Beverage container deposit legislation is an ingenious approach to the incorporation of the external costs of beverage consumption. By demanding the restructuring of the beverage distribution system, influencing consumer behavior, and thereby inducing restructuring of the production system, deposit legislation not only internalizes much of the pre-legislation external costs, but actually reduces the total true cost by eliminating a significant portion of the externalities. The problem is attacked from two sides. (See Figure 1.)

The curve labeled S represents the marginal private costs of beverage consumption before deposit legislation, Q being the original quantity. The true costs (private + external) of beverage consumption before deposit legislation are represented by S^1. This indicates that the pre-legislation optimal quantity would have been Q_1. Net total costs exceeded the optimal by the area of the triangle BTF. Deposit legislation would induce changes which would reduce the externalities by the amount $S^1 - E = E_R$. An amount of external costs equal to $E - S = E_L$ would remain. Associated with these changes is a private cost increase equal to $S^{11} - S$. The true social cost (private + external) with deposit legislation would be equal to $S^{11} + [E - S] = J$. The post-deposit legislation quantity would be Q_2.

Hence we see that deposit legislation would result in an amount of net benefits equal to the area of triangle BTF minus the area of triangle RLN. The existence of triangle RLN indicates that even further action could be justified in bringing about an optimal result. Post-deposit legislation consumption would be at Q_2 whereas, assuming no further decrease in total cost, the optimal quantity would be Q optimal. A reduction and/or internalization of external costs equal to $E_D = E_L$ would be desirable.

HOW IT WORKS

By requiring a deposit be paid on all beer and soft drink containers purchased, consumers are provided with an economic incentive to return the containers – the first vital step toward the achievement of the proposed goals of deposit legislation. Figures 2 and 3 illustrate how the deposit system works. Retail

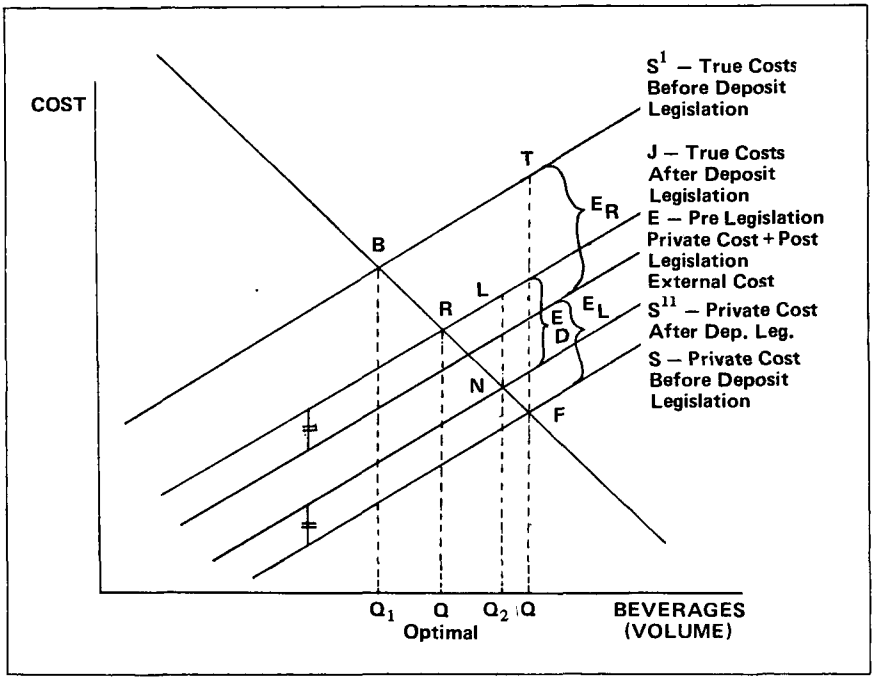


Figure 1.

outlets are required by law to accept those containers of the type which they sell and refund deposits accordingly. Distributors (beer), bottlers (soft drink) and canners (soft drink) would also be required by law to demand a deposit be paid to them by retailers and must also accept all types of containers which they sell.

Deposit legislation would require nothing beyond the return of the non-refillable containers to the beer distributor and soft drink bottler or canner. What happens to the non-refillables beyond this point is left to the producers and distributors. For non-refillables, it is most often profitable for the aluminum scrap – and to a lesser extent the steel scrap and glass cullet – to be sold to container manufacturers and smelters. For refillable containers, brewers and soft drink bottlers would most often find it more profitable to transport, wash and refill existing bottles than to purchase new bottles; and they may place a deposit on their refillable bottles to assure their return.

The cost advantage of refillables is greater on the average for soft drink producers since they are located more regionally relative to brewers. As transportation costs increase, they may begin to outweigh the economics of scale of large national breweries. This suggests a possible future trend toward regional rather than national breweries.

The additional costs associated with this new distribution system are more than compensated for by the decrease in container cost per filling. This decrease

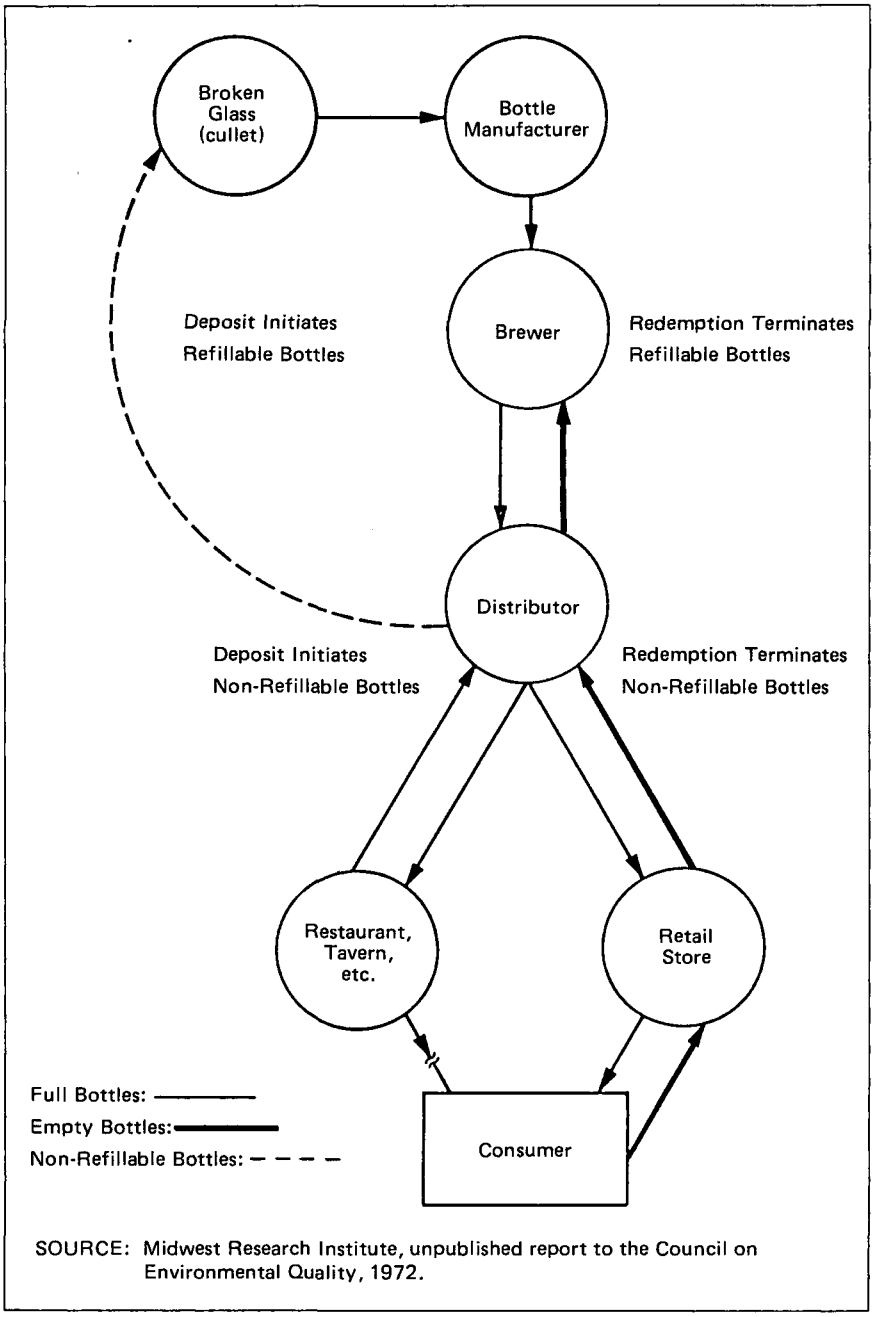
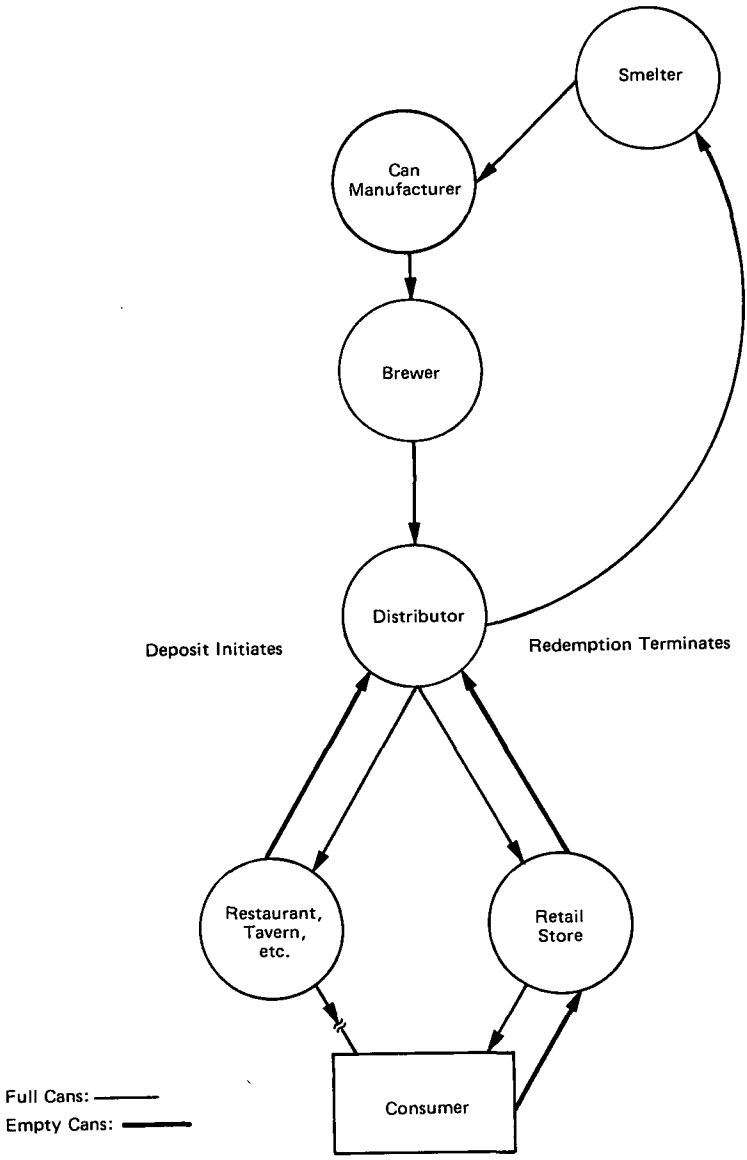


Figure 2. Container flow system: beer – bottles.



SOURCE: Midwest Research Institute, unpublished report to the Council on Environmental Quality, 1972.

Figure 3. Container flow system: beer — cans.

in container cost is due to reuse of refillables and the fact that it is less costly to produce® cans and bottles from recycled materials than it is from raw materials. Although many brewers and soft drink manufacturers may not themselves realize all of the cost savings attributable to the reuse and recycling of the beverage containers, there are nevertheless real net social cost savings.

Claims of large total deposit system cost savings are based on a sufficiently high average return rate for all containers, usually about 90 per cent. This assumption is well founded in terms of historical evidence, return rates in those states which currently have deposit legislation, and the fact that sufficiently high return rates can be assured by raising the amount of the deposit [1, p. 9]. A return rate of 90 per cent appears to be a floor rate for economic use of the refillable bottle [2, p. 29]. The author assumes throughout this analysis that a minimum 90 per cent average return rate of all containers is achieved.

MARKET SHARES

The nature of the cost savings, and, to a somewhat large but not crucial degree, the magnitude of the cost savings, depend on the new market shares of the various container types. There is general agreement among researchers that there would be a desirable shift away from the use of costly non-refillable bottles, and a lesser degree of agreement as to the size of the new market shares of cans and refillable bottles. Most reports, however, predict a greater increase in the use of refillable bottles relative to cans. The metal can mix would most likely shift away from steel (bimetal) cans and toward aluminum cans because of the higher value of aluminum in the recycling markets. There has been a significant trend toward the increased use of non-refillable containers since 1959 [2, p. 76].

Table 1 presents two typical predictions (Mix I and Mix II) of container market shares with deposit legislation and without deposit legislation (termed "baseline").

Table 1. Projected Impact of National Deposits on Beverage Container Mix (Per Cent of Beverage Volume)

			1985 Deposit Legislation	
	1977	*1985 Baseline*	*Mix I*	*Mix II*
Refillable Glass Bottles	27	20	40	60
Non-refillable Glass Bottles	25	15	10	5
Non-refillable Plastic Bottles	0	10	10	10
Metal Cans	48	55	40	25

SOURCE: See [2, pp. 29-30].

It is important to note that deposit legislation does not dictate the use of any particular container type. The market is left with a great deal of freedom in this respect. This is an extremely desirable aspect of deposit legislation since it encourages technological and systematic innovation in the production of refillable and recyclable containers.

LITTER AND SOLID WASTE

Beer and soft drink containers comprise between 20 to 30 per cent of all roadside litter by item count and 40 to 60 per cent on a volume basis [3, p. 69; 4, p. 356]. Deposit legislation can significantly reduce the size of our national litter problem. The deposit serves as an economic disincentive to litter beverage containers, in addition to providing an incentive to pick up littered containers to redeem them for their refund value.

Deposit legislation could decrease the number of beer and soft drink containers littered by 70 per cent [3, p. 69]. Annual minimum cost savings of $68 million would be realized. Of these $68 million in cost savings, $59 million would be reductions in public sector litter collection costs and $9 million would be reductions in the cost of injuries due to litter (not including value of work lost as a result of injuries) [1, pp. 19-22]. In addition, large amounts of resources which are now being used by government and beverage industry sponsored litter control programs could be diverted to more productive uses. Significant unmeasurable aesthetic damage caused by litter could also be prevented.

Deposit legislation would reduce the solid waste stream through the reuse and recycling of containers. A reduction of between 1 per cent and 5 per cent of the total residential and commercial solid waste stream is predicted. Collection and disposal cost savings of $20-95 million would be realized [1]. The most important cost feature to be looked at in the long run is the ever increasing cost of disposal due to the increasing scarcity of land.

NATURAL RESOURCES

The containers which deliver the over ten billion gallons of packaged (other than kegs and syrup) beer and soft drink produced in the U. S. each year consume large quantities of natural resources. To get an idea of how much beverage ten billion gallons is, it is enough to fill over 107 billion twelve ounce containers. Deposit legislation can save considerable amounts of energy resources, aluminum, iron ore and many other materials which are used in the mining, manufacture and packaging of beverage containers. Although the distribution system would become more transport intensive, the increased resource use in this sector would be insignificant relative to the amount of resources saved through the reuse and recycling of containers.

Table 2. Total System Energy Consumption of Various Container Types

	Baseline	*Deposit Legislation*
Refillable Bottle (10-Ret)	21.60	21.60 (mil. BTU/000 gals.)
One-Way Glass Bottle	64.00	64.00
Bimetal Can	51.45	30.98
Aluminum Can	65.45	15.33
Plastic Bottle	63.00	63.00

SOURCE: See [1, p. 31].

Sand and aluminum, the two primary materials in beverage containers, are not considered particularly scarce resources on a worldwide basis. Aluminum reduction however, is a very energy intensive process. Glass is made from a special kind of sand, and must be heated to 2600°F. in order to be used to create a beverage container [5, p. 68]. Beverage container production can be a very energy intensive process.

In a deposit system, energy is saved due to the interrelated impacts of a change in the nature of container market shares and an increase in container recycling rates. Implementation of a deposit system would induce an increase in the use of refillable bottles (see Table 1). The deposit which would be placed on all containers would increase considerably the recycling rate of aluminum cans. The same holds true for the bimetal can, but to a lesser extent.

As shown in Table 2, in the present non-deposit system (baseline), refillable bottles with a minimum 10-trip[1] use the least amount of energy. Aluminum cans are presently the most conspicuous energy consumers. Recycling an aluminum can consumes 95 per cent less energy than producing a can from scratch. Hence we see that a shift to refillable bottles and an increase in the aluminum recycling rate would save considerable amounts of energy resources.

It is interesting to note that in our present system the refillable bottle consumes the least amount of energy whereas in the deposit system, with increased recycling rates, the aluminum can emerges as the most energy efficient container (see Table 2)[2].

[1] The relationship between trippage and return rate is basically:

$$\text{Trippage} = \frac{1}{\text{1-Return Rate}},$$

hence a 90 per cent return rate would yield trippage of 10.

[2] Note that in Table 2, the deposit legislation energy consumption figure for aluminum cans is not 95 per cent less than the baseline figure. This is because some aluminum cans are already being recycled in the baseline year.

The Resource Conservation committee estimates that deposit legislation would result in a total system (from extraction through delivery) energy savings of up to 134 trillion BTU's (British Thermal Units) annually, depending on the container mix [6, p. 43]. The Office of Solid Waste estimates a savings of 245 trillion BTU's annually, equivalent to 125,000 barrels of oil per day, or an approximate 40 per cent reduction of 1980 energy use for the consumption of beverages [3, p. 70]. A Federal Energy Administration sponsored study projects a savings of 144 to 169 trillion BTU's annually [7, p. 4]. A net saving of 1.4 trillion BTU's annually has been realized in the new system in Oregon alone, enough to supply the heating needs of 50,000 Oregonians [7, p. 4]. Dr. Carlos Stern, Economics, University of Connecticut, studied the situation and concluded, "If the nation would go to a national bottle bill (all-refillable system), the annual savings in energy would equal the output of twelve nuclear power plants of the 1,000-megawatt size." [7]

THE ENVIRONMENT

Apart from the frequently mentioned environmental disamenities associated with litter and the disposal of solid waste, there are numerous disamenities associated with the mining, exploration, manufacturing and transportation involved in the production of beverage containers. The production of beverage containers imposes costs on people, wildlife, and natural systems, both directly as in air pollution from container manufacturing plants and indirectly as in the mining pollution due to the extraction of fuels for these plants. Deposit legislation can have a significant positive impact upon the environment's burden of our present system.

It is estimated that deposit legislation would result in a 52 to 86 per cent reduction in industrial solid wastes, a 44 to 70 per cent reduction in atmospheric emissions, and a 44 to 69 per cent reduction in waterbone wastes, from our present system [2, p. 42]. There would also be significant reductions of environmental damage due to the foregone mining of energy and other raw material resources which cannot be measured in terms of amounts of wastes or emissions.

Conserving resources would not only save "user cost," the foregone extractive output, but would also save the value of the undisturbed environment. This gain in value would be in perpetuity, that is the value of a natural environment would be realized every year that the environment remains undisturbed. If we choose to extract resources from this environment instead, we would be foregoing a possible infinite stream of benefits from this environment.

Conservation of a resource decreases the future cost of the resource by reducing its scarcity. Present conservation not only reduces present externalities and future internal costs but can also reduce future externalities. Since energy resource substitutes of the near future produce a much larger degree of

externalities, conservation of present resources can in fact reduce the external costs of future energy consumption by postponing the time at which these externally costlier resources become internally cost advantageous.

Besides the environmental and user costs of raw material consumption, there are additional external costs due to our dependence upon foreign supplies of these resources. The U. S. has in the past decade become acutely aware of our vulnerability to the restriction of our raw material supplies. A comprehensive study by the International Economic Studies Institute suggests the U. S. is exposed to problems of national significance not only in the supply of petroleum but also in bauxite and many other materials [8]. Ninety per cent of our bauxite, the primary component of aluminum, is imported. Economically useful deposits of bauxite in the U. S. have long been sufficient to meet only a small fraction of demand [8, p. 11].

Dependence upon foreign supplies makes us vulnerable to the imposition of shortages and price manipulation. The more our economy is dependent on these resources, the more costly becomes a disruption of the economy caused by an unanticipated shortening of supply. The less dependent we are upon petroleum, the greater our ability to undercut OPEC's monopoly pricing power. Our capabilities for short run substitution of energy resources are far from perfect. An example of present and probably increased future costs are our heavy military expenditures in defense of oil supplies. There are also many potential future costs in terms of human lives lost in such a defense.

Many opponents of deposit legislation view it as an ineffective means of reducing national energy consumption. They cite the fact that deposit legislation would only reduce national energy consumption by less than one half of 1 per cent. This may sound trivial, but it is not. Deposit legislation would save more energy than the state of Maine is currently using [9, p. 68]. The reason it may seem trivial is because the 100 per cent national energy consumption figure is so large. All of our energy problems cannot be solved by reducing energy consumption in any one way or in any one place, but through the combination of small conservation efforts in many different areas. The most economically efficient way of solving the whole is to solve for the parts by methods which are appropriate to the characteristics of the individual parts.

CAPITAL

Deposit legislation would increase the need for some types of capital equipment and decrease the need for others. The shift to a new container mix would increase capital requirements in the beer and soft drink manufacturing, distribution and retail segments of the beverage system associated with the increased use of refillables, and decrease future investment requirements in the production of one-way containers and container systems. Some capital equipment devoted to one-way containers would be allowed to depreciate during

a transition period but it is not easily determinable just how much of this depreciation would be premature.

The nature of the transition is primarily industry determined. The industry is confronted with a few simple rules. There is no requirement to shift to refillables. Beverage producers would do so because now that they would be assured of a high rate of return of their containers, they would find it more profitable to refill containers than to purchase new ones. Predictions of net long run capital cost increases associated with the deposit system average zero [1].

EMPLOYMENT

Deposit legislation would result in a net increase in the level of employment and the total wage bill. As the demand for new containers decreases and the distribution and retail sectors expand, there would be an increase in employment in the distribution and retail sectors and a decrease in employment in the glass container, metal can, and steel and aluminum production industries. Beer and soft drink producers would also require more workers for their increased bottle washing and handling activities. A net increase in employment of approximately 54,000 would result [1, p. 46].

Approximately two thirds of the gross number of new jobs would be low skilled, low paying jobs in the retail sector involving the handling of returned containers. The remaining third would involve relatively high skilled and high paying jobs in distribution, production and filling. Those jobs which would be lost are primarily high skilled and high paying jobs in the sectors producing containers and supplying container materials. Unemployment has been greatest among low skilled laborers, hence deposit legislation would decrease unemployment where it is highest. Two factors which would tend to mitigate the negative employment impacts over the transition period are non-beverage container related growth and normal attrition in the affected industries.

PRICES

Deposit legislation would result in either very small or nonexistent price increases or decreases. Most predictions are that given sufficient return rates, prices would go down. Reports from states which have had deposit legislation for more than a few years indicate that prices have on the average decreased slightly [1, p. 58]. Small price increases might occur in the short run as the beverage production, distribution, and retail sectors experience transitional costs.

As a result of lower container costs, average wholesale prices would decrease. Offsetting this price decrease would be a price increase due to increased distribution costs. Price increases would also likely occur at the retail level due to increased retail handling costs. Lower container costs would most likely more than offset increased distribution and handling costs. Another factor which

would work in the direction of a price decrease would be the substantial additional income received by distributors for the highly valued aluminum cans which they would collect. Temporary relative price distortions between container types may occur as the industries involved attempt to influence the container mix so as to benefit the most from existing production capacities.

CONSUMER CONVENIENCE

Deposit legislation would result in a loss of convenience associated with the returning of containers. The inconvenience would lie in the time, effort and bother incurred by the necessity to store and transport the containers and return them during shopping trips. There would be, however, many consumers who would experience an increase in consumer convenience as a result of deposit legislation.

In 1979, refillable bottles captured 22 per cent of the beverage market. Deposit legislation would increase convenience for this 22 per cent of the market by providing for greater return ease of containers. There are also many consumers who previously delivered cans and non-refillable bottles to recycling centers who would now have a greater number of return outlets. In addition, there are those consumers who would purchase refillables now if they were more widely available. It we conservatively estimate that these latter two types of consumers comprise an additional 3 per cent of the market, then we find that a total of 25 per cent of the market would experience a gain, rather than a loss, of convenience. The net total loss of consumer convenience would be equal to the loss of convenience of the remaining 75 per cent of the market minus the gain of convenience of this 25 per cent of the market.

CONCLUSIONS

We can conclude that national beverage container deposit legislation is an effective and efficient means by which a significant number of the external costs of beverage consumption may be internalized or eliminated. True net long run benefits are to be realized from the passage of deposit legislation, for which transitional costs should be sacrificed. As can be seen upon examination of Table 3, consumer inconvenience emerges as the conspicuous unmeasurable long run internal cost factor against which numerous benefits must be weighed.

It is important to realize that the individual consumer, acting alone, does not believe he has, nor does he in fact have, the option of trading his own convenience for the alleviation of a significant amount of the externalities of the present convenience oriented system. Many consumers are not even aware of the connection between the present beverage system and its external costs, but nevertheless demand a clean environment, lower fuel costs and the alleviation of other external costs of beverage consumption. Out of the desire to do something

Table 3.

Net Long Run Costs	*Net Long Run Benefits*
Capital	
Very small or nonexistent long run capital cost increase	or decrease
Prices	
Very small or nonexistent price increases	or decreases
Consumer Convenience	
Loss of convenience of 75% of market minus gain of convenience of remaining 25% of market	
	Natural Resource Conservation
	Energy
	Petroleum
	Coal
	Nuclear
	Hydro
	Raw Materials
	Bauxite
	Iron Ore
	Other
	Litter Reduction
	Collection
	Injuries
	Control Programs
	Aesthetic
	Solid Waste Stream Reduction
	Collection
	Disposal
	Land
	Environmental Degradation Reduction
	Mining
	Manufacturing
	Employment
	Net increase in level of employment and total wages paid

about these external costs emerges the demand for collection action. National beverage container deposit legislation is a cost effective form which this action may take.

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