Canada's Deposit Refund System for Beverage Containers

Tasmia Zaman Apsara, BBA
MEEM
Thompson Rivers University
Bob Gaglardi School of Business and Economics
Kamloops, British Columbia
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Email: zamanapsarat22@mytru.ca

Abstract:
A deposit-refund system (DRS) is a mandatory or voluntary program that requires a minimum refundable deposit on beer, soft drinks, alcohol, and other beverage containers to ensure a high recovery rate of containers for recycling or reuse (BottleBill.org, 2003). A deposit-refund system combines a chargeable deposit (fee) on a commodity with a refundable credit (return) upon the execution of a desired action, which is usually the return of the used containers (BottleBill.org, 2003). Due to the return of the used containers, these containers are saved from further damaging the environment in the form of litter, which saves the cost of litter recycling, as well as being reused to produce recycled containers rather than the production of new plastic.

Background:
The Deposit Value of containers that consumers pay when they buy a beverage range from $0.05 to $0.35, depending on the container type and province (CM Consulting, 2014). On average, if $0.20 is the deposit value on beverage container purchases, then a full deposit refund of 20 cents should maximize the refund of the containers, which should ultimately reflect as a welfare gain.

Objective and Methodology:
The concept is to increase the deposit refund amount for consumers who return the beverage containers to encourage them to return more in quantity or to increase the number of consumers who return containers. This way, more plastic can be recycled without incurring litter collection costs as well as reducing new plastic production. A relationship is formed between the deposit refund amount for the returned containers and the quantity of returned. The social surplus with or without the DRS system is also calculated to assess the welfare (or loss). A policy recommendation is provided depending on the outcomes. Following are some key terms that will be used to assess whether the amount of refund for deposits for the deposit refund system (DRS) should be higher or if it should stay the same.

Preliminary data:

Category	*Parameter*	*Value*	*Notes*	*Reference*
Refund Amounts	Non–half-back provinces (Except half back provinces)	$0.05 per unit	Provinces that refund the full deposit amount for returns	CM Consulting (2014)
	Half–back provinces (NS, NB, PE, NL)	$0.10 per unit	Provinces that refund half of the deposit amount for returns	CM Consulting (2014)
	Canada–wide average refund	$0.10 per unit	Current Refund amount	CM Consulting (2014)
	Refund for 90% recovery target	$0.20 per unit	Future refund amount to achieve goal	Eunomia (2024)
Recovery Rates	Non–half-back provinces	75%		BottleBill.org (2003)
	Half–back provinces	86%		BottleBill.org (2003)
	Average rate with DRS	65%		(Eunomia, 2024)
	No DRS (recovery rate)	35% (65% not recovered)		
	Target (Zero Plastic Waste Goal)	90%		Eunomia (2024)
Cost Parameters	Marginal Private Cost (MPC)	$0.05 per unit (range: $0.02–$0.07)	Cost of Recycling (includes handling fees)	CM Consulting (2014)
	Marginal External Cost (MEC)	$0.30 per unit	Cost of Litter Cleanup	(CM Consulting, 2024)
	Total litter cleaned annually	16% (Made In CA, 2024)	% of total plastic containers sold	Made In CA (2024)
Supply Curve & Elasticity	Supply Curve Points	(Refund: $0.05, Recovery: 75%), (Refund: $0.10, Recovery: 86%), (Refund: $0.20, Recovery: 90%)		–
	Slope of Supply Curve	(0.86 – 0.75) / (0.10 – 0.05) = **2.2**	Using half-back and non-half-back refund amounts and recovery rates	
	Short Run Elasticity	((0.86 – 0.75) × 0.05) / ((0.10 – 0.05) × 0.75) ≈ **0.15**	Using half-back and non-half-back refund amounts and recovery rates	The supply is inelastic (<1)
Intercept	Total plastic containers sold (α)	220,000 tons annually		Eunomia (2024)

Table 1: Preliminary data and supply curve component calculation.

For the simplicity of calculation, three recovery rates of the containers have been considered instead of the quantity of containers. The quantity of containers is, however, incorporated later in the social surplus analysis, where total plastic beverage containers in tonnes are converted to kilograms.

Assuming the **supply curve** is linear, we get:

$Q_s = \alpha + \alpha\_1 P\_s$

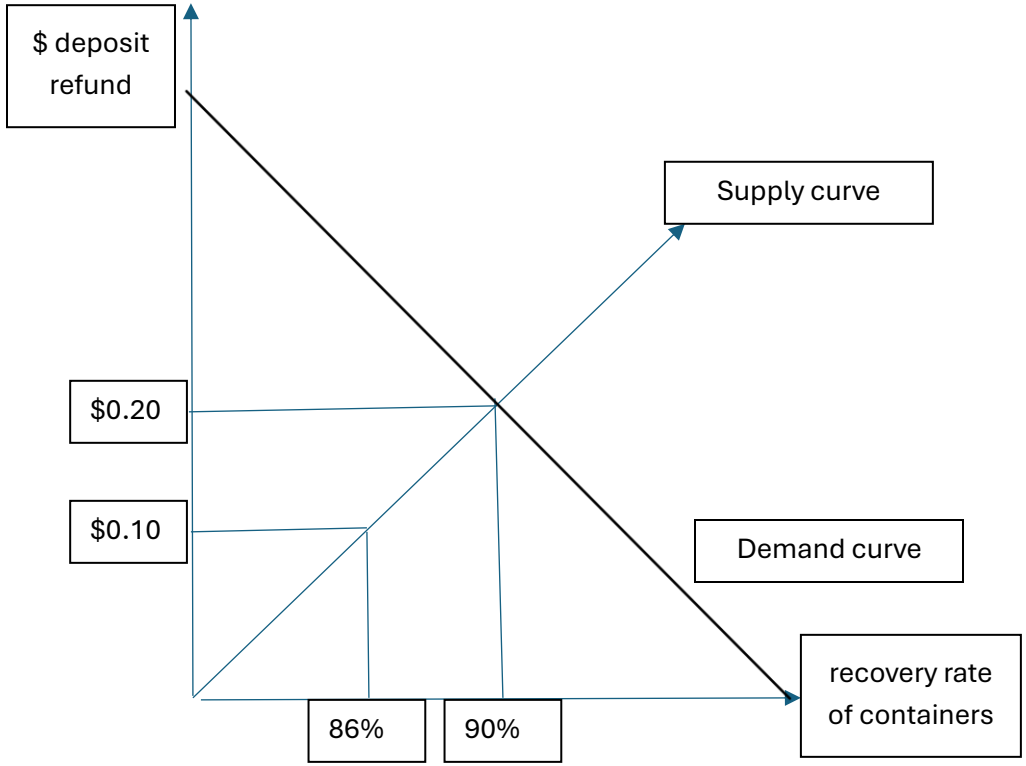

Figure 1: Supply curve of container returns in Canada (figure not to scale).

The slope of the supply curve is typically positive, reflecting the direct relationship between price and quantity demanded (as price rises, quantity demanded increases).

$Q\_(s)$ is the number of recovered containers due to DRS, which depends on the rate of recovery.
α (intercept) is the total plastic containers sold annually in Canada in tons, which is estimated at 220,000 (Eunomia, 2024)
$P\_(s)$ is the deposit refund amount per container for returned ones based on the size of the containers and provinces.
$\alpha\_(1)$ is the slope of the supply curve, which is 2.2. It means that if the price increases by 1%, the quantity of containers returned increases by 2.2%.
This is generally the case with inelastic supply, where consumers are slightly responsive to price changes.
To assess the responsiveness of supply to price changes in percentage terms, we also measure the price elasticity in the short run.
We can see through the short-run elasticity that it is inelastic and less than 1. The positive sign indicates that the price increase of deposit refund will result in a quantity increase.

Table 2: Social Surplus Analysis

Scenarios	Value	Notes / Comments
Pre–Policy (No DRS)		
Consumer Surplus (benefit of container recovery)	$0	–
External Cost (litter recycling)	– $0.30 × 0.65 × 220,000t = **–$42.9M per year**	(1 ton = 1000 kg)
Post–Policy (With DRS)		
Consumer Surplus (CS)	0.65 × 220,000t × $0.10 = $14.3M per year	(1 ton = 1000 kg)
Producer Cost (PC)	$0.05 × 0.65 × 220,000t = $7.15M per year	(1 ton = 1000 kg)
External Cost Savings (EC)	– $0.30 × (0.65 – 0.16) × 220,000t = –$32.3M/ year	(1 ton = 1000 kg)
Social Surplus	CS – PC – (–EC) = $14.3M – $7.15M + $32.3M = **$39.5M per year**	(1 ton = 1000 kg)

Table 3: Policy Recommendation

Policy Recommendation	Value	Notes / Comments
Introduction of New Deposit Refund	$0.20 per unit	To achieve a 90% recovery target
Consumer Surplus (New)	0.90 × 220,000 × $0.20 = $39.6M per year	–
Net Surplus Gain	(0.90 – 0.65) × 220,000 × ($0.10 + $0.20) = $16.5M per year	Additional surplus from the new policy
Welfare Gain under New Policy	$39.5M + $16.5M = **$56M per year**	–

Findings:

Scenario	Social Surplus
No DRS	-42.9 million per year
With DRS	39.5 million per year
New Policy with DRS	56 million per year

Table 4: Summary of Scenarios

Hence, if the deposit amount is increased to 20 cents in addition to the current DRS system, it increases the quantity of returns in turn resulting in = $ (39.5 + 16.5) M or approximately 56 million per year in welfare gain. This is additional $16.5 million gained annually, towards being more sustainable, reducing litter cleanup costs as well as increasing consumer benefits in the form of deposit returns.

Limitations:

1. There has been no consideration of inflation on DRS deposit values for last several decades (CM Consulting, 2014)
2. Long term elasticity was not calculated which could have shown more convincing results.

Reference:

CM Consulting. (2014). Financing beverage container reuse and recycling. CM Consulting Inc. https://www.cmconsultinginc.com/wp-content/uploads/2014/07/FINANCING-BEVERAGE-CONTAINER-REUSE-AND-RECYCLING.pdf

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Appendix 1: Formula used

- The slope of the supply curve = $(\Delta r \div \Delta P)$
- Short Run Elasticity = $[(r\_2 - r\_1) \times P\_1] \div [(P\_2 - P\_1) \times r\_1]$
- Consumer surplus (benefit of container recovery) = $rate\_(No\ DRS) \times \alpha \times \$0.00$
- External Cost (recycling costs without DRS) = - **MEC** $\times\ rate\_(No\ DRS) \times \alpha$
- Consumer Surplus (CS (benefit from DRS) = $rate\_DRS \times \alpha \times P_{current\ refund}$
- Producer Cost, PC (recycling) = **MPC** $\times\ rate\_(DRS) \times \alpha$
- External cost (savings), EC= - **MEC** $\times$ **(**$rate\_DRS - rate\_litter$**)** $\times \alpha$
- Net Surplus gain = $(rate\_uture - rate_{DRS}) \times \alpha \times (P_{current\ refund} + P_{future\ refund})$