Assessing impact of a flat and variable deposit fee for UK Deposit Return Scheme

Final report

LE London Economics

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Executive Summary

Following the recently passed regulations implementing a Deposit Return Scheme (DRS) in Scotland in July 2022 (Scottish Government, 2020), the UK and Welsh Governments and the Department for Environment, Agriculture and Food in Northern Ireland (DAERA) are considering introducing a similar scheme in England, Wales and Northern Ireland (Defra, 2019). The DRS would aim to incentivise consumers to return their drinks containers by charging a deposit fee at the point of purchase, refundable upon the return of the container. The DRS aims to increase recycling rates to reduce littering and CO_2 emissions by increasing the use of recycled materials replacing virgin materials which have a higher carbon footprint and reducing incineration of highly polluting materials (Defra, 2019).

Between February and May 2019, the UK Government undertook a public consultation on the merits of introducing a DRS in England, Scotland, Wales and Northern Ireland (Defra 2019). Overall, 84% of respondents to the consultation agreed with the DRS principles as set out in the consultation document citing the benefits of increased overall recycling rates and a reduction in waste.

In light of this context, Alupro engaged London Economics to undertake an economic assessment of a DRS in the UK.

Alupro is very interested in the design of a future deposit return scheme and believe a variable deposit should be a key component of the scheme's design. Alupro are concerned that stipulating a flat deposit fee of 20p, as the Scottish Government has done, will have negative unintended consequences. Alupro is concerned that a flat fee deposit return scheme will lead to consumers switching to larger PET bottles from smaller portion formats, like aluminium cans in multipacks.

This study examines how an introduction of a DRS in the UK might affect drinks container producers, particularly focusing on the aluminium can production industry. Overall, there is limited research on the impact of deposit fees on consumers' choice of packaging materials. Policy assessments tend to focus on the impacts that the deposit fees have on the drinks market and not the packaging material market. These assessments tend not to investigate if the DRS would favour one packaging material (e.g. plastic bottles) over another (e.g. cans).

The study considered three situations:

1) a situation in which there is no DRS in operation (the baseline);
2) a flat rate DRS where each container regardless of type and size is charged a flat rate deposit return fee of 20p at point of purchase; and,
3) a variable rate DRS in which the deposit fee varies between 20p and 50p depending on the size of the container.

In order to account for differences in consumer behaviour under the introduction of a DRS, the flat and variable rate settings are combined with four alternative behavioural scenarios.[1] These scenarios impact how the consumer perceives the deposit fee when they purchase a drink. For example, a consumer who knows they will return their empty container knows the deposit is returnable and they will receive their money back in the future. On the other hand, a consumer who

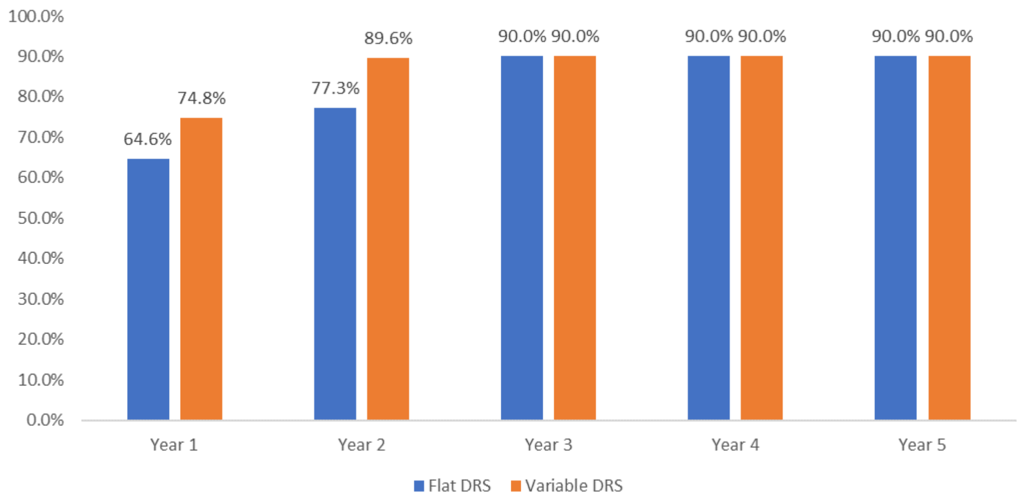
[1] Four behaviour scenarios are considered. These are explained in section 3.

does not believe they will return their container views the deposit fee as a tax which they cannot recover. How the consumer perceives the deposit fee at point of purchase will, in turn, influence their demand response to a DRS.

Return Rates

Flat and variable rate DRS are both capable of delivering high return rates. Most existing DRS schemes that operate in other countries report a return rate of approximately 90% after two to three years in operation irrespective of whether the scheme is flat or variable. If we assume that newer schemes have lower rates of return in their early years as customers become used to returning their containers, the return rates for flat and variable rate schemes are very similar. However, variable rate schemes achieve higher return rates in the first two years of operation (Figure 1).

Figure 1 Overall return rates by type of DRS (%)



Source: London Economics' analysis based on the consumer survey (section 3.8)

Economic impact

The economic impact (sales and revenues) on aluminium can producers is lower under a variable DRS, and this is particularly the case in the first two years of the scheme. In the first year of a DRS, the revenue and sales generated under the variable rate DRS scenario are 12.3% higher than those generated under the flat rate DRS. In the second year, the difference is 7.6%. Over the 5 year modelling period can producers' revenue and sales are 6% larger under a variable DRS.

The introduction of a DRS decreases the total sales of both PET bottles and cans. Compared to a no-DRS baseline, under a flat rate DRS, 3,244 million fewer units of cans are sold over the 5 year period (just under 7%). This compares to 407 million fewer PET bottles (0.76%) (Table 1, scenario 1). Under a variable rate scheme 736 million fewer units of cans are sold (1.57%) compared to 1,503 million fewer PET bottles (2.82%). It should be noted that under either scheme, more PET bottles will be sold than cans. A variable rate scheme has a lower negative impact on can producers than a flat rate scheme.

Table 1 Change in total units of PET and cans sold by DRS type

Scenario	Total *plastic* bottles sold in the market over 5 years (in millions)	Difference in plastic bottles sold relative to baseline (%)	Difference in plastic bottles sold relative to baseline (in million units)	Total *cans* sold in the market over 5 years (in millions)	Difference in cans sold relative to baseline (%)	Difference in cans sold relative to baseline (in million units)
No DRS baseline	53,341	0.00%	0	46,810	0.00%	0
Flat rate DRS: scenario 1 - everyone knows whether they will return	52,934	-0.76%	-407	43,566	-6.93%	-3,244
Flat rate DRS: Scenario 2 - everyone believes they will not return	51,467	-3.51%	-1,874	31,878	-31.90%	-14,932
Flat rate DRS: scenario 3 - everyone believes they will return	53,247	-0.18%	-94	46,063	-1.59%	-747
Flat rate DRS: scenario 4 - everyone is unsure about whether they will return	52,722	-1.16%	-618	41,882	-10.53%	-4,927
Variable rate DRS: scenario 1 - everyone knows whether they will return	51,838	-2.82%	-1,503	46,074	-1.57%	-736
Variable rate DRS: scenario 2 - everyone believes they will not return	44,637	-16.32%	-8,704	46,081	-1.56%	-728
Variable rate DRS: scenario 3 - everyone believes they will return	53,247	-0.18%	-94	46,063	-1.59%	-747
Variable rate DRS: scenario 4 - everyone is unsure about whether they will return	50,468	-5.38%	-2,872	46,569	-0.51%	-240

Source: London Economics' calculations based on Statista, Nielsen and Defra (2019) data

The product fees under a variable DRS are estimated to be lower than under a flat rate DRS for each material examined (cans, PET and Glass). Across the 5 year modelling period product fees are 84% lower for PET and 24% for glass. Product fees are negative for cans under both designs. Under the variable DRS scheme, operator revenue from unredeemed deposits and recyclates mean that product fees for all materials can be set lower than under a flat rate scheme in order for the scheme to break even.

Other impacts

The demand for large single PET and small multipacks of large PET is estimated to increase post-DRS (for both DRS types) relative to the no-DRS baseline. However, the demand for larger PET containers increases by less under a variable rate DRS compared to a flat rate DRS.

When respondents to the survey conducted as part of this study were asked how much they tend throw out of their beverages, among those who report wasting a portion of the beverage, nearly 30% of respondents reported wasting 10-25% of contents in large PET bottles (2 litres) compared to just under 18% for cans.

As demand for large single PET bottles increases under a flat rate DRS, this may have implications for portion control. As portion size increase, findings from pre-existing literature suggest that consumption may also increase (the 'portion size effect'). This can have health implications for UK consumers.

1 Introduction

1.1 Context

England, Wales, and Northern Ireland are currently considering introducing a deposit return scheme (DRS).[2] The key objective of the scheme would be to further stimulate growth in recycling rates to ensure the appropriate disposal of drinks containers (Defra, 2019). According to Defra (2019), the inappropriate disposal of such containers generates negative externalities to the UK economy, such as littering and increased CO_2 emissions due to the insufficient use of recycled materials to produce drinks containers.

The scheme would add deposit fees to the prices of drinks that are in scope at the point of purchase to incentivise consumers to recycle their drink containers. The fees would be redeemed when the empty drinks containers are returned to return points.

A DRS may charge a flat rate deposit fee on all containers irrespective of size and packaging material – a flat rate DRS. Alternatively, a DRS may charge different deposit fees based on the size of the drink and/or packaging material – a variable rate DRS.

The Scottish Parliament has passed regulations to implement a DRS in Scotland in July 2022.[3] The scheme will charge a flat rate. Consumers will pay a deposit fee of 20p when they buy a drink in a single use container sized from 50ml to 3L. Materials in scope include PET plastic, metal, and glass.[4]

Under a flat rate DRS, the deposit fee does not change proportionally to the volume of the drink. For example, both a 330ml can and 2L bottle will be charged 20p. Furthermore, if a consumer can either buy a multipack of 6 cans or a 2L bottle to purchase 2L of the same drink, the multipack would be charged 6 times the deposit fee compared to the 2L bottle.

1.2 Main aims of this research

Alupro is interested in the design of any future DRS scheme in England, Wales, and Northern Ireland. Alupro has commissioned London Economics to research the impact of a flat rate DRS on the UK aluminium drinks packaging market, compared to a variable rate scheme.

This research investigates the extent to which a flat rate and variable rate scheme will change consumers' choice for packaging materials when buying drinks. Specifically, the study assesses:

- whether a DRS will change consumer demand for drinks in aluminium cans and the subsequent economic impact on the aluminium industry – revenue, volume of cans on the market and gross value added (GVA);
- the environmental impact due to a potential change in packaging mix in the market;
- the public health impact due to consumers potentially buying drinks in different sized containers; and,

[2] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/826853/drs-consult-sum-resp1.pdf

[3] https://www.gov.scot/policies/managing-waste/deposit-return-scheme/

[4] For more, see https://depositreturnscheme.zerowastescotland.org.uk/faqs#What's

- the impact of a flat rate scheme on DRS financing.

The research examines the impacts of a UK wide DRS rather a DRS limited to England, Wales and Northern Ireland only.

The research includes alcoholic and non-alcoholic beverages.

1.3 Methodology

To complete this research, London Economics has:

- reviewed existing relevant research on DRSs;
- collected and collated a range of data including data on the UK drinks market and performance indicators of other countries' DRSs;
- run and analysed a survey on consumer responses to a DRS;
- spoken with a small number of stakeholders to validate the impact estimates; and,
- built a model to estimate consumers' demand response to flat rate and variable rate deposit fees.

2 Review of DRS experience in other countries

2.1 DRS design

DRSs have been implemented in a number of countries across Europe and other parts of the world such as Australia. Some countries run flat rate schemes, where the same level of deposit fee is put on all drinks in scope regardless of drink type, volume, and packaging material. Other countries operate variable rate schemes. Table 1 presents countries which have DRSs and what types of schemes they use.

Table 2 Examples of countries with DRSs

Country	Type of Scheme
Australia	Flat
Croatia	Flat
Denmark	Variable
Estonia	Flat
Finland	Variable
Germany	Flat
Iceland	Flat
Lithuania	Flat
Norway	Variable
Sweden	Variable

Note: While single use containers in Germany are charged a flat rate, different deposit fees are charged on reusable containers.
Source: London Economics analysis based on scheme operators' publications and CM consulting and reloop (2018). 'Deposit Systems for One-Way Beverage Containers: Global Overview.'

As presented in Table 3, flat rate deposit fees vary across countries[5]. The deposit fees in most flat rate schemes are typically less than 10p. However, Germany charges the highest rate at about 20p.

[5] The fees have been converted into pounds for ease of comparison.

Table 3 Flat rate schemes

Country	Deposit fee [1]	Overall return rate [2]
Estonia	£0.09 (0.10 EUR)	83% [3]
Germany	£0.22 (0.25 EUR)	98% [3]
Iceland	£0.10 (16 ISK)	90% [3]
Lithuania	£0.09 (0.10 EUR)	92% [4]
Croatia	£0.06 (0.50 HRK)	87% [3]
New South Wales, Australia	£0.05 (0.10 AUD)	60% [5]
Northern Territory, Australia	£0.05 (0.10 AUD)	75% [5]
Queensland, Australia	£0.05 (0.10 AUD)	30% [5]
South Australia, Australia	£0.05 (0.10 AUD)	77% [5]
Australian Capital Territory, Australia	£0.05 (0.10 AUD)	53% [5]

Note: [1] Deposit fees have been converted from national currencies to British pounds using 2019 exchange rates retrieved from OECD https://data.oecd.org/conversion/exchange-rates.htm#indicator-chart [2] Return rates were recorded in 2017 for Estonia, 2015 for Germany, 2014 for Iceland, 2017 for Lithuania, 2016 for Croatia, 2019 for New South Wales, 2017 in Northern Territory, 2019 for Queensland, 2017 for South Australia and 2019 for Australia Capital Territory. [3] CM consulting and reloop (2018). Deposit Systems for One-Way Beverage Containers: Global Overview. [4] https://www.economist.com/europe/2020/01/11/why-lithuanians-cash-in-on-their-trash [5] ICRC (2019) Container Deposit Scheme Price Monitoring https://www.icrc.act.gov.au/__data/assets/pdf_file/0020/1407602/Container-Deposit-Scheme-Price-Monitoring-Final-Report.pdf
Source: London Economics analysis based on scheme operators' publications and CM consulting and reloop (2018). 'Deposit Systems for One-Way Beverage Containers: Global Overview.

Deposit fees in a variable scheme can vary by volume or packaging material, or both. Table 3 illustrates the ways in which the deposit fees vary in countries in which variable rate schemes have been implemented. In Norway, the deposit fees only vary by volume. Large drinks (0.5L or more) are charged higher deposit fees than smaller drinks (less than 0.5L). The deposit fee on a plastic bottle is the same as on a can if they are both less than 0.5L (or if both are more than 0.5L). In other cases, the deposit fees are different across cans, glass bottles and plastic bottles, even if they have the same volume. For example, in Denmark, the deposit fees on 1L or smaller PET bottles are higher than the deposit fees on glass bottles and cans of the same volume. In Finland and Sweden, variable rates only apply on plastic bottles. The deposit fees on PET bottles are higher for large bottles, even though cans are charged the same rates across all sizes.

Table 4 Variable rate schemes

Country	Material	Volume	Deposit fee [1]	Overall return rate [2]	Type of variable rate scheme
Denmark	Glass	Less than 1L	£0.12 (1.00 DKK)	92% [3]	Deposit fees vary by volume and material. The deposit fees on small containers are higher for PET bottles than other materials. But the deposit fees on large containers are the same across all materials.
	Glass	1L or more	£0.35 (3.00 DKK)		
	PET	Less than 1L	£0.18 (1.50 DKK)		
	PET	1L or more	£0.35 (3.00 DKK)		
	Can	Less than 1L	£0.12 (1.00 DKK)		
	Can	1L or more	£0.35 (3.00 DKK)		
Sweden	PET	1L or less	£0.08 (1.00 SEK)	85% [4]	Only the deposit fees on PET vary by volume. The deposit fees on all cans are the same. (The scheme operator reports that all Swedish cans are no more than 1L.) [7]
	PET	More than 1L	£0.17 (2.00 SEK)		
	Can	1L or less	£0.08 (1.00 SEK)		

Norway	PET	Less than 0.5L	£0.09 (1.00 NOK)	92% [5]	Deposit fees vary by volume only.
	PET	0.5L or more	£0.22 (2.50 NOK)		
	Can	Less than 0.5L	£0.09 (1.00 NOK)		
	Can	0.5L or more	£0.22 (2.50 NOK)		
Finland	Glass	All	£0.09 (0.10 EUR)	92% [6]	Only the deposit fees on PET vary by volume. All cans and glass bottles face a flat rate.
	PET	Less than 0.5L	£0.09 (0.10 EUR)		
	PET	Between 0.5L and 1L	£0.18 (0.20 EUR)		
	PET	More than 1L	£0.35 (0.40 EUR)		
	Can	All	£0.13 (0.15 EUR)		

Note: [1] Deposit fee has been converted from national currency to British pounds using 2019 exchange rates retrieved from OECD https://data.oecd.org/conversion/exchange-rates.htm#indicator-chart [2] Return rate was recorded in 2016 for Finland and Norway, 2019 for Denmark and Sweden. [3] Dansk Retur system https://danskretursystem.dk/en/sustainability/ [4] Pantamera https://pantamera.nu/pantsystem/statistik/pantstatistik/ [5] CM consulting and reloop (2018). Deposit Systems for One-Way Beverage Containers: Global Overview. [7] From Pantamera *https://pantamera.nu/pantsystem/fakta/burk-pet/ "The volume of the jars varies between 15 cl to 95 cl, the most common jar holds 33 cl."*

Source: London Economics calculations based on sources listed in note to table

2.2 Return rates in flat and variable rate schemes

A key indicator of success of a DRS is its return rate. The return rate measures the proportion of containers on the market that are returned to the scheme operator. It also indirectly indicates the level of uptake of the scheme – the more people participate in the scheme, the higher the return rate.

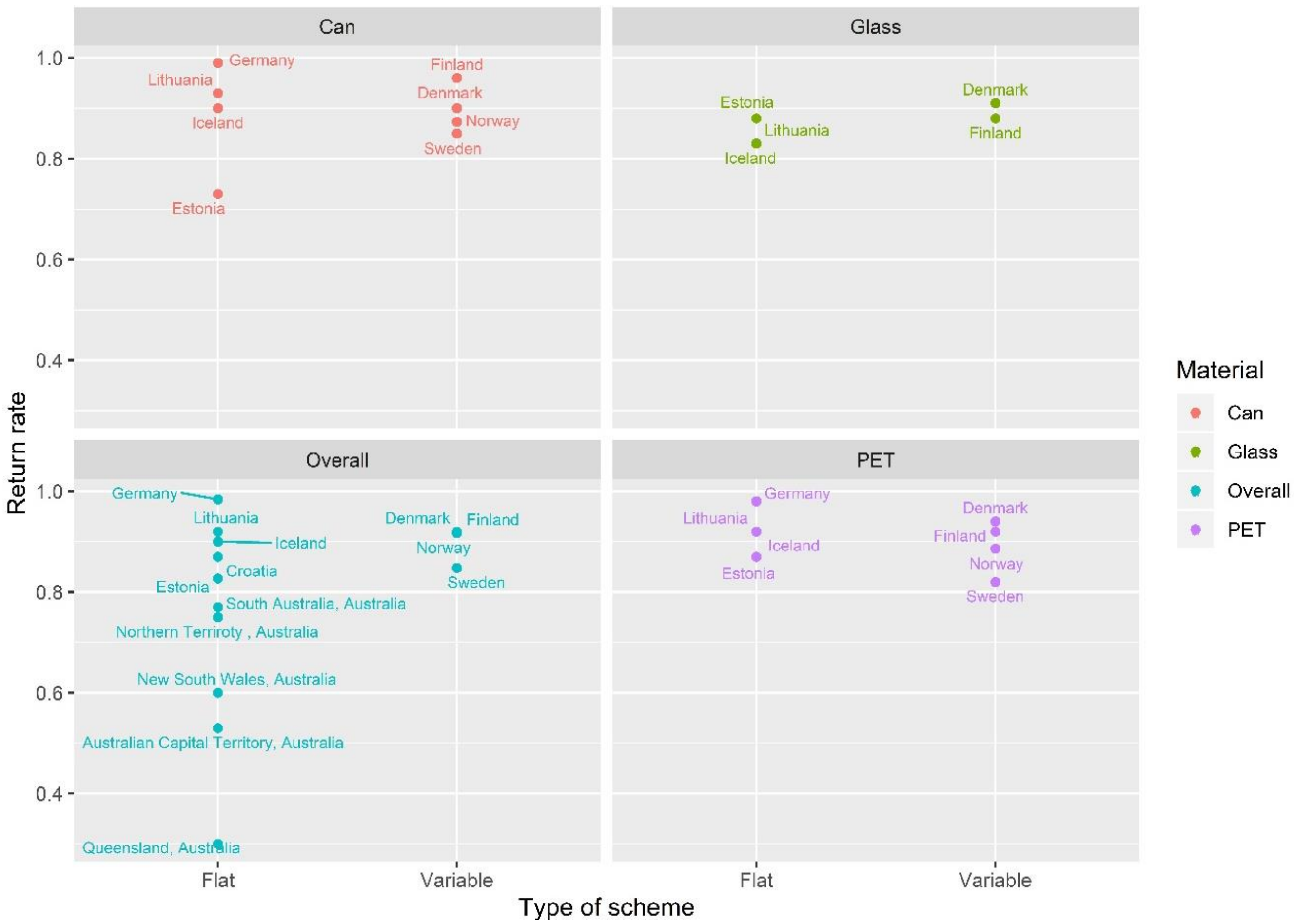
Figure 1 shows the return rates in flat and variable rate countries. As some countries publish their return rates for each material in scope, the figure also shows return rates by packaging material where possible. The return rates are recorded for the latest years for which data are available. The oldest data were recorded in Iceland, 2014. Annex 1 details the underlying data.

All variable rate schemes recorded return rates of 80% or more across all materials, while flat rate schemes' return rates were between 30% and 99%. While both types of schemes have examples of high return rates, the dispersion in variable rate countries is lower.

Although it seems that variable rate countries tend to realise higher overall return rates than flat rate countries (bottom left in Figure 1), it should be noted that Australian schemes have been implemented recently. All Australian states and territories introduced their DRSs within the last three years, with the exception of South Australia and Northern Territory, whose schemes were introduced in 1977 and 2012, respectively. If we assume that newer schemes have lower rates of return in their early years as customers become used to returning their containers, the return rates for flat and variable rate schemes are very similar.

Therefore, there is some evidence to suggest that both types of schemes can deliver high return rates.

Figure 2 DRS return rates, by material and country



Source: London Economics calculations based on scheme operators' publications and CM consulting and reloop (2018). 'Deposit Systems for One-Way Beverage Containers: Global Overview.'

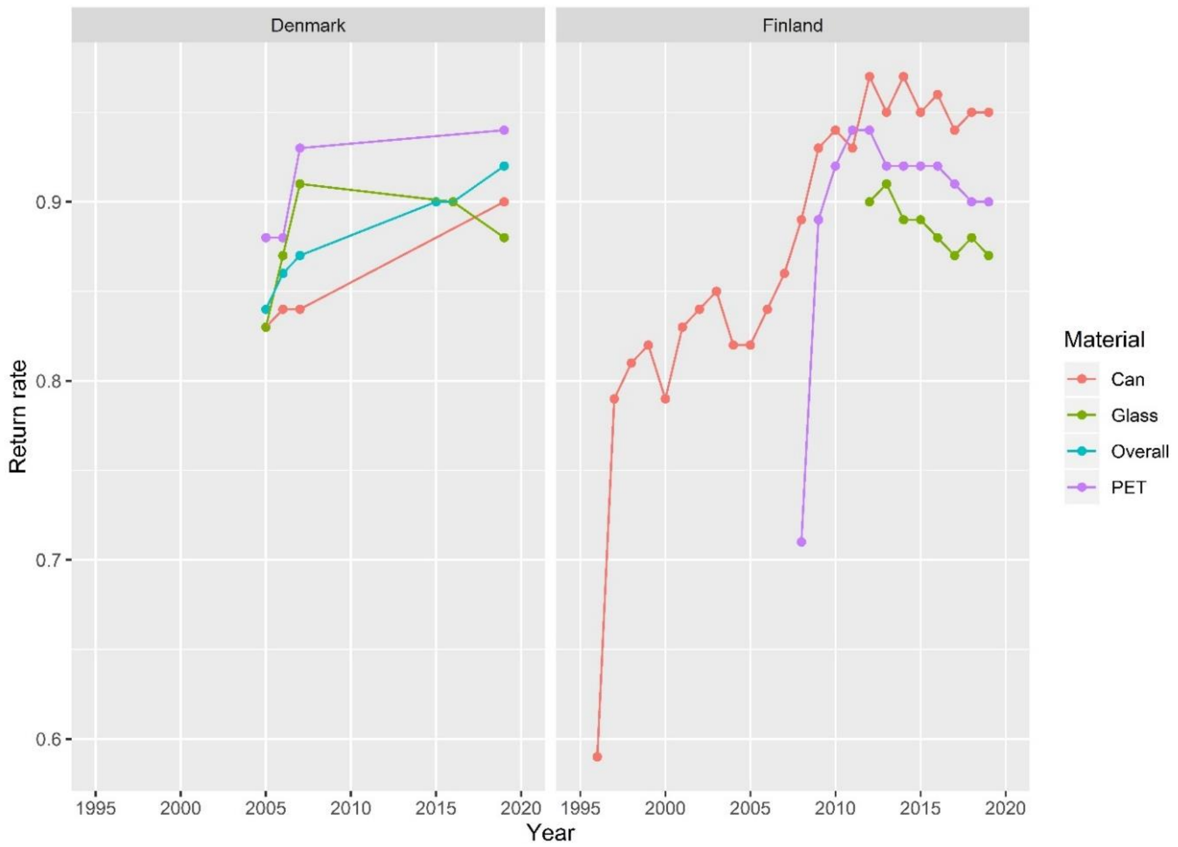
2.3 Return rates over time

Figure 3 gives some indication that return rates are likely to increase over the lifetime of a DRS. The left panel of the graph shows changes in return rates of different materials over time in Denmark, who introduced their DRS in 2002. The right panel shows the equivalent data for Finland, who introduced a DRS for cans in 1996, PET bottles for 2008 and glass bottles in 2012. Finland reports annual data while the data reported for Denmark is sparser.

As Figure 3 shows, all materials in Denmark, except glass, had higher return rates in 2019 than 2015. The overall return rate was at 84% in 2005, rising to 90% in 2015 and 2016, and reaching 92% in 2019. In Finland, the return rate for cans was at 59% in 1996, though it rose to 79% in the following year. It then generally remained above 80% in the 2000s and stayed above 90% between 2010 and 2019. Similarly, although the return rate for PET bottles in Finland was low initially, at 71% in 2008, it increased and then remained above 90% between 2010 and 2019. Glass bottles in Finland are similar to those in Denmark in terms of return rate performance, where the return rate has not exhibited an upward trend over time.

Overall, Denmark and Finland's DRSs illustrate that return rates are likely to be lower in the first years and be higher as the scheme matures.

Figure 3 Return rates in Denmark and Finland over time, by material (Denmark: 2005 – 2019; Finland: 1996-2019)



Note: The overall return rate in Finland is not available over time.

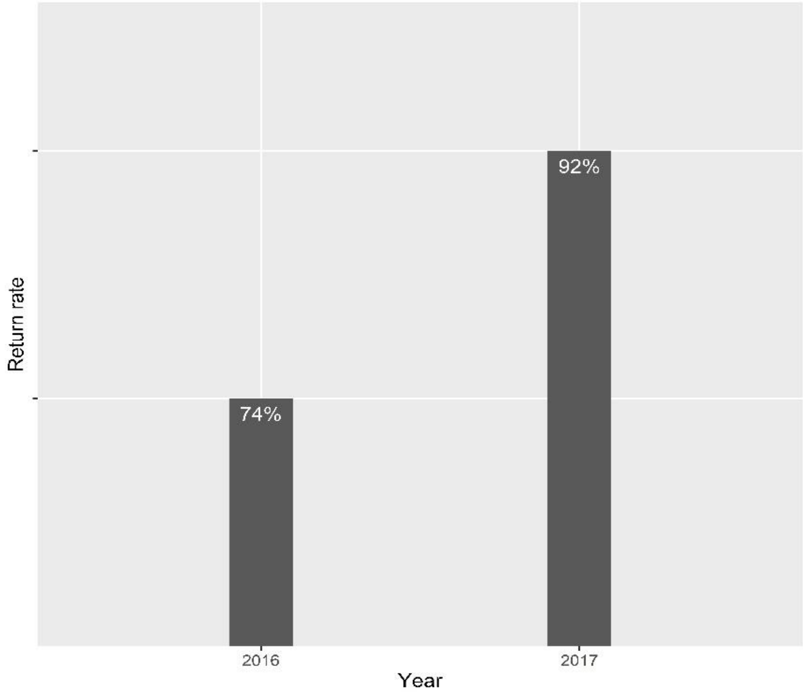
Source: London Economics analysis based on scheme operators' publications

Return rates in flat rate schemes are also likely to rise over time. In the first year of the scheme in Lithuania, the overall return rate was 74%, before increasing to 92% in year two (Figure 3). Furthermore, regulations[6] in Scotland set the target return rate to be low in the first year of the scheme with expected growth in the rate over time. The target return rate has been set at 70% in the first year, 80% in the second year, and 90% in the third year and thereafter.[7]

[6] https://www.gov.scot/publications/deposit-return-schemme-scotland-regulations-accompanying-statement-proposed-regulations/

[7] https://depositreturnscheme.zerowastescotland.org.uk/information-producers

Figure 4 Return rate in Lithuania, 2016 and 2017



Note: The overall return rate in 2018 and 2019 are not publicly available.

Source: London Economics analysis based on Balcers et.al. (2019') 'Deposit Return Systems for Beverage Containers in the Baltic States. Riga: Green Liberty'. Retrieved 27 August 2020 from https://www.researchgate.net/publication/332242306_Deposit_Return_Systems_for_Beverage_Containers_in_the_Baltic_States_Rga_Green_Liberty

Overall, the evidence suggests that either a flat or variable rate scheme can take time before the return rates reach 90% or above. This finding will inform the modelling. If unredeemed deposits are estimated to have an impact on the UK market, these impacts will be greatest in the first years of the scheme.

2.4 Return rates and deposit fee level

Finally, return rates are assessed against deposit fees. Figure 3 seeks to see if higher return rates tend to be associated with higher deposit fees. Two adjustments to the deposit fees are made in the figure. Firstly, deposit fees are converted into US dollars adjusted by Purchasing Power Parity (PPP) to allow for cross-country comparisons[8]. Secondly, the deposit fee for each type of packaging material in a given country is derived as the arithmetic mean of the deposit fees across different volumes within the same material. For example, glass bottles in Denmark are charged $0.15 in PPP for those sized 1L or less and $0.45 in PPP for those bigger than 1L, the average deposit fee for glass is then $0.30 in PPP[9].

As Figure 3 shows, return rates tend to be lower when the deposit fees are lower. Australia and Sweden, which are countries with low deposit fees in PPP terms, also have lower return rates.

[8] In short, PPP is an exchange rate that converts one country's currency into another while taking into account of the differences in living costs.

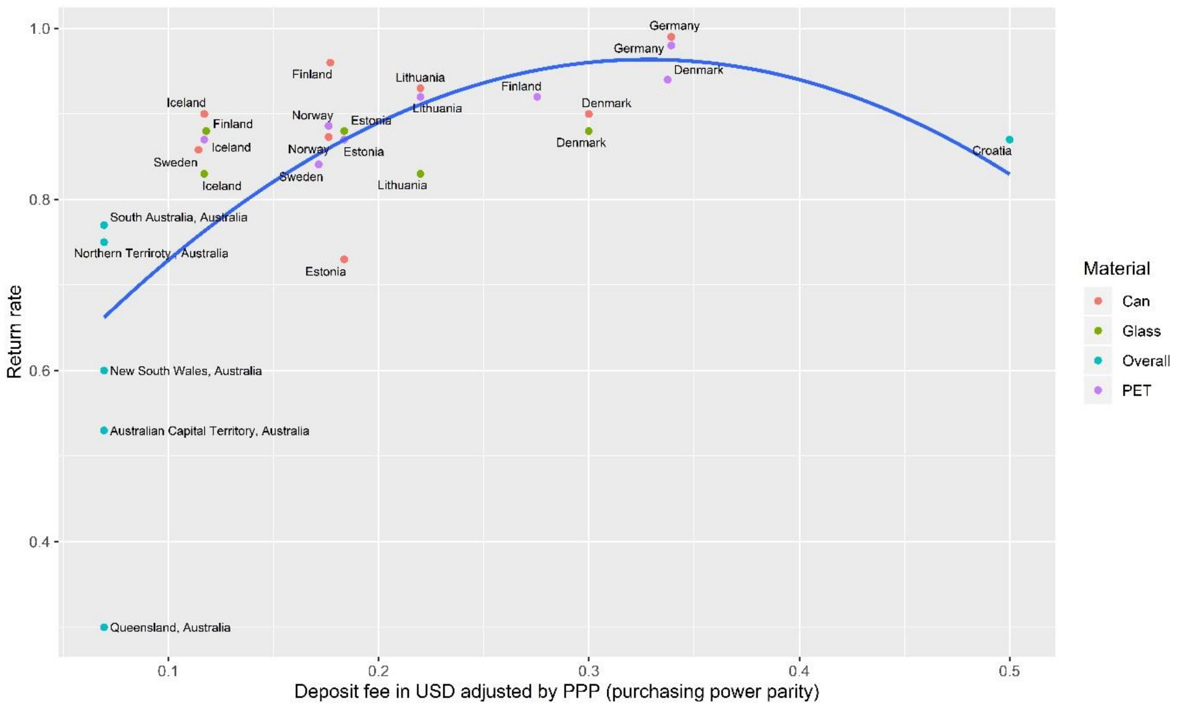
[9] ($0.15+$0.45)/2=$0.30

Countries such as Germany, Denmark, and Lithuania, who have higher deposit fees in PPP terms, have higher return rates.

The figure also fits a simple econometric model describing the general relationship between return rate and deposit fee[10]. The model predicts that the deposit fee that would achieve the highest return rate is $0.33 in PPP (approx. £0.22). However, the results should be interpreted with caution. This is because the sample size is small, and the model does not estimate the ideal deposit fees for each material or volume separately.

The general observation is that higher deposit fees tend to achieve higher return rates, though raising fees that are already high enough may fail to attain even higher return rates. Furthermore, the econometric model suggests that it would be possible to realise a return rate of 90% or above if deposit fees lie between $0.21-0.45 in PPP (approx. £0.14 - 0.31).

Figure 5 Return rate and deposit fee level (purchasing power parity adjusted)



Note: Deposit fees have been converted from national currencies to PPP in USD using 2019 exchange rates retrieved from OECD https://data.oecd.org/conversion/purchasing-power-parities-ppp.htm#indicator-chart. The exchange rate implies that $1 in PPP buys £0.68.

Source: London Economics calculations based on scheme operators' publications and CM consulting and reloop (2018). 'Deposit Systems for One-Way Beverage Containers: Global Overview.'

10 Using the equation $Return.rate_{c,m} = \alpha + \beta_1 deposit.fee_{c,m} + \beta_2 deposit.fee_{c,m}^2$, where c denotes country and m material. All variables in the equation are statistically significant at 1%.

2.5 Impact of deposit fees on consumer demand

Overall, there is limited research on the impact of deposit fees on consumers' choice of packaging materials. Policy assessments tend to focus on the impacts that the deposit fees have on the drinks market and not the packaging material market. In other words, whether the DRS would favour one drink type over another. These assessments tend not to investigate if the DRS would favour one packaging material (e.g. plastic bottles) over another (e.g. cans).

The Scottish Government's business and regulatory impact assessment for a DRS (2019), groups impact into direct and indirect impacts. The direct impacts affect those who sell, produce, and import drinks, while the indirect impacts concern the producers of packaging and labelling materials. The impact assessment mainly focuses on the direct impacts. Nevertheless, findings that can help inform the modelling for this study are summarised below.

Regarding the direct impact on drinks prices, the impact assessment argues that the impact will be small because the deposits will be refundable. Nevertheless, the impact assessment suggests that a DRS will place a 'real cost' on consumers even if they are refunded the deposits.

The real cost comes from unredeemed deposits *and* participation in the scheme. In cases where containers are not returned, consumers bear the cost of deposits. Even in the cases where the containers are returned, consumers bear the cost of effort to participate the scheme.

The Scottish Government suggests a range of factors that determine the cost of effort[11]:

- **Disposable income.** Those on low disposable incomes may live on tight budgets and spend as much as they earn, or more by borrowing. Until the deposits are redeemed, there exists a temporary window where the money is locked away. Spending and finances could be disrupted as a result. The inconvenience to take part for these consumers may be high.
- **Attitude towards recycling.** Participation would be more enjoyable for those who have a positive attitude towards recycling. The cost of effort and inconvenience would be perceived lower.
- **Current recycling activity.** Consumers who currently recycle may get accustomed to the DRS with less effort.
- **Proximity to deposit return points.** The effort to travel and return containers may be smaller for those who are close to return points.
- **Consumption patterns of DRS applicable drinks.** Certain consumption patterns may mean that there are more containers for some consumers to deal with and return.

The impact assessment references research from Slovakia which estimated that if the country implemented a DRS, the real cost per Slovak citizen would likely be £2.24 - £3.46 annually (approx. 0.6p – 1p per day). Based on this research, it was then estimated that the real cost per container in Scotland would be 0.5p in the low scenario, 1p in medium scenario and 1.5p in high scenario. In the model built by London Economics, this real cost will affect consumer demand.

[11] Scottish Government only lists the factors and does not explain them. The explanation to each factor is written by London Economics.

As the impact assessment estimates the real cost to be the same for drinks of all sizes, it notes that the real cost per ml on smaller products would be higher than the larger equivalent products. The assessment therefore indicates that the flat rate DRS may lead to consumers shifting from smaller to larger containers. However, it argues the shift would be small. Even though some packaging materials tend to be used to sell larger drinks, the assessment does not discuss the impact on packaging material manufacturers.

The Scottish Government's report generally suggests that a DRS is unlikely to shift consumers from buying drinks in one packaging material to another. However, the report refers to a piece of research in the US that found that if the state of Kentucky implemented a DRS, the sales of drinks at groceries stores that border non-deposit states would likely decline by 3.2%. This potentially indicates that deposits can change consumer behaviour. In this instance, consumers may avoid paying deposit fees by going to a different state. Consumers may also choose different packaging material if it means a lower deposit fee for the same amount of drinks.

In summary, the Scottish impact assessment made limited investigation into the indirect impact of DRS on the market of packaging materials. The assessment only examines the competition between DRS applicable materials and non-applicable materials and concluded the competition impact would be small.

The Independent Competition and Regulatory Commission (2019) undertook a competition assessment of the DRS in the Australian Capital Territory. Similarly, this assessment limited their research on the scheme's direct impact on drinks, including whether some drinks' prices had increased disproportionally more than others due to the DRS. The assessment concluded that the price increases across all drinks were reasonable.

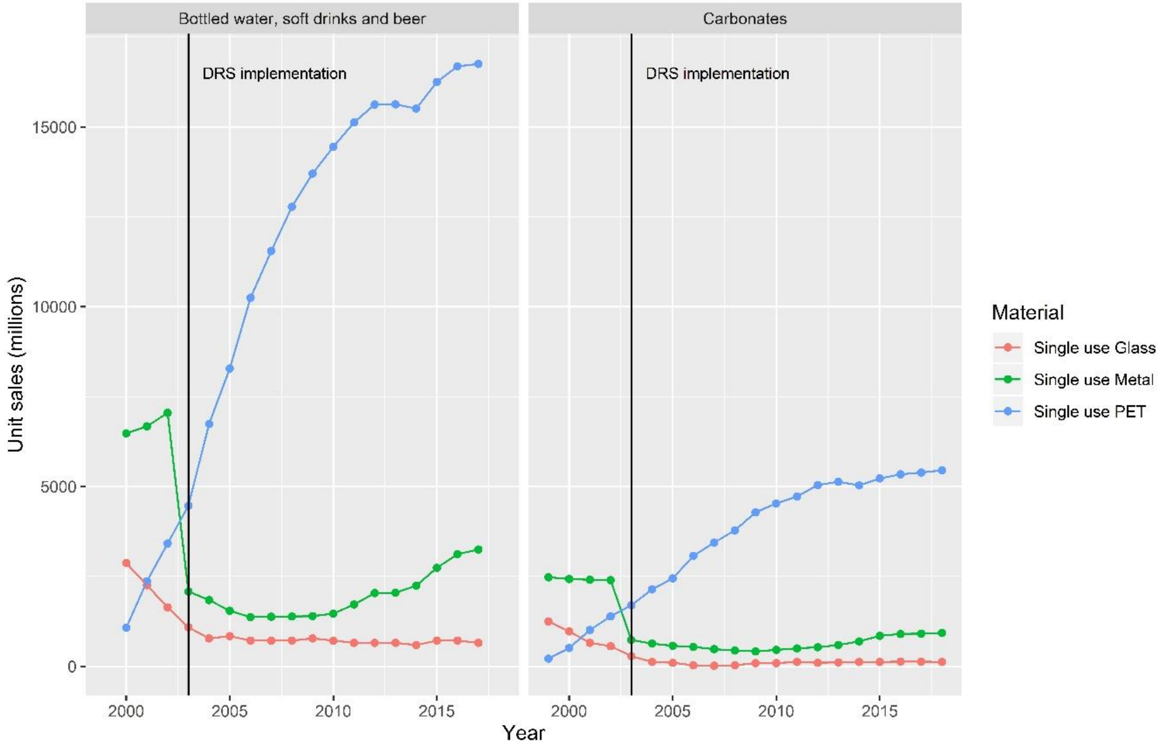
Although there is limited research on the impact of DRSs on consumers' demand for drinks in different packaging materials, some studies have shown that a DRS can affect drink producers' choice for packaging materials. Lee et.al (2019) argues that because glass bottles are more expensive to handle and recycle, they have lower reseller values than cans. Drink producers therefore tend to pay higher product fees[12] on glass bottles. Lee et.al points to the beer markets in Croatia and Denmark, where the use of metal packaging had seen sizeable growth since the schemes were introduced, while the growth in the use of glass and PET had remained flat or declined.

Another example is Germany. Markus (2008) points out that when the DRS was first introduced in Germany in 2003, retailers were only required to take back the containers that they sold. Retailers avoided taking back competitors' products. They were able to do so by using bottles of particular shapes. However, this was not possible with cans as they had a common shape. Consequently, as Markus argues, some retailers stopped selling drinks in cans.

There are some indications of the substitution away from cans in German sales data. Figure 6 illustrates the sales of drinks in Germany in the years before and after DRS implementation. The left panel shows the sales for bottled water, soft drinks and beer. The right panel shows the sales of carbonates. In 2003, the units of drinks sold in metal fell sizably in both panels. The sales then remained low and did not recover to pre-DRS levels. In contrast, the units of drinks sold in PET bottles grew in 2003 and continued growing thereafter as seen in both panels below.

[12] These are the fees that a drink brand or importer pays the scheme operator for putting drink containers on the market.

Figure 6 Sales of units of drinks in Germany by material, before and after DRS



Source: London Economics analysis based on information in Lee et.al (2019). 'Recycling DRS in Scotland'. Retrieved 1 September 2020 from https://www.britglass.org.uk/sites/default/files/Recycling%20DRS%20in%20Scotland_OHL%20report_Final.pdf

2.6 Key points

- International examples examined in **section 2.2** indicate that both variable and flat rate schemes have achieved high return rates.
- Historical return rates in international schemes and Scottish DRS' target rates suggest that return rates are likely to increase over the lifetime of a DRS (flat or variable) (**section 2.3**).
- The statistical relationship between deposit fees and return rates is positive. **Section 2.4** shows that higher deposit fees tend to be associated with higher return rates.
- **Section 2.5** presents literature on the impact of DRSs on consumer demand. Though most studies find a limited competitive impact of DRSs, the focus tends to be on the drinks market only and not on the packaging market. There is some evidence that DRSs could have an impact on *producers'* choice for drinks packaging materials.

3 Consumer response to DRS

This section discusses the potential demand responses that consumers may have to a UK flat or variable DRS. This research models two types of DRS:

- Flat DRS
  - 20p deposit fee on all containers.
- Variable DRS
  - 20p deposit fee on small containers, 500ml or less.
  - 40p deposit fee on medium containers, larger than 500ml and up to 1L.
  - 50p deposit fee on large containers, larger than 1L and up to 2L.

The research also estimates the return rates in the flat and variable rate DRS based on the consumer survey results.

This research has:

- built a model that contains four scenarios where consumers have different perceptions of deposit fees at point of purchase (sections 3.2-3.5);
- conducted a consumer survey which estimates consumer demand sensitivity to price changes (sections 3.6 and A2.1); and,
- estimated return rates of different sized containers at various deposit fee levels, using the consumer survey (section 3.8 and A2.1.2).

3.1 Context

A flat rate DRS charges 20p on all containers in scope. At the point of purchase, the prices of drinks in aluminium cans increase more in relative terms than the same drinks in PET bottles. Table 5 presents some illustrative average prices that consumers would pay for a soft drink with and without a flat rate deposit fee of 20p.

The percentage increases in the prices in cans are higher. For a single can, 20p is proportionately large to the original price. The 20p amounts to a 32% increase in price in percentage terms, while the single unit PET counterpart increased in price by 20%. For the 6 pack, each can in the 6 pack is charged 20p, making the total deposit fee 1.20p (49% price increase), while a 1L PET bottle is charged only 20p (17% price increase).

Table 5 Price change for a soft drink (flat rate deposit fee of 20p)

Packaging format	Price before flat rate DRS	Price after DRS	Percentage change in price
Single 330ml can	£0.62	£0.82	32%
6 pack of 330ml cans	£2.44	£3.64	49%
500ml PET bottle	£0.99	£1.19	20%
2L PET bottle	£1.17	£1.37	17%

Note: The price of a 500ml PET bottle calculated for alcoholic drinks. All the other prices are shown for carbonated soft drinks.
Source: London Economics calculations based on Nielsen market data

However, a deposit fee is likely to affect demand differently from a tax. A consumer that returns the container is refunded the full deposit. They face no price increase overall. However, the consumer may not know whether they will return the container. Furthermore, as the consumer pays the deposit fee upfront, they will have the refunded money later rather than now.

To capture the varying possible demand responses, the model estimates the impact of DRS for four scenarios:

- **Scenario 1:** all consumers know whether they will return their containers.
  - Therefore, some consumers will perceive the deposit fee as a tax and some consumers will perceive it as refundable.
- **Scenario 2:** all consumers believe that they will not return their containers.
  - Therefore, all consumers perceive the deposit fee as a tax.
- **Scenario 3:** all consumers believe that they will return their containers.
  - Therefore, all consumers perceive the deposit fee as refundable.
- **Scenario 4:** all consumers are unsure whether they will return their containers.
  - Therefore, all consumers perceive a portion of the deposit fee as a tax. This is because even if they do return the containers, the cost of paying 20p today is greater than the benefit of receiving 20p tomorrow (this is referred to as 'present bias').

3.2 Scenario 1: all consumers know whether they will return their containers

In this scenario, consumers know whether they will return their containers at the time of purchase, so they understand the prices that they pay.

For those who do not return the containers, the prices that they pay are increased by the full deposit fees:

- Under the flat rate scheme, the prices increase by 20p on all containers.
- Under the variable rate scheme, the prices increase by 20p on all small containers (500ml or less), 40p on medium containers (larger than 500ml and no greater than 1L), and 50p for larger containers (larger than 1L and no greater than 2L).

For those who do return the containers, the prices they pay do not include the deposit fees. However, their prices will increase by a cost of effort. The cost of effort represents the time and effort that the consumer takes to return a container. For example, consumers may need to store the containers somewhere and travel to the return points. The Scottish Government (2019) estimates that the cost of effort is equivalent to placing between 0.5p to 1.5p on each container bought (Table 6).

Table 6 Cost of effort associated with returning containers

	Low	Medium	High
£ per container	0.5p	1p	1.5p

Source: Scottish Government (2019) 'A Deposit Return Scheme for Scotland - Full Business Regulatory Impact Assessment'. Retrieved 25 August 2020 from: https://www.gov.scot/publications/deposit-return-scheme-scotland-full-business-regulatory-impact-assessment/

The model uses 1p to capture the cost of effort. The prices that the returning consumers pay increase by 1p in both flat and variable rate schemes.

The model uses the return rates to determine the share of consumers that will and will not return containers. These are estimated from the consumer survey which asked respondents how likely they are to return containers of different sizes with different deposit fees (described in section A2.1). Table 7 presents the overall return rates for both types of DRS.

Table 7 Overall return rates used in scenario 1

	Year 1	Year 2	Year 3	Year 4	Year 5
Flat rate DRS	64.6%	77.3%	90.0%	90.0%	90.0%
Variable rate DRS	74.8%	89.6%	90.0%	90.0%	90.0%

Note: The return rates in year 1 are estimated from the responses from the consumer survey. The growth in return rates is modelled following the Scottish DRS target rates. This growth modelling is explained in section 3.8.

Source: London Economics

To illustrate, in year 1, under a flat rate scheme, about 65% of the drinks' prices increase by 1p as just under 65% of consumers return their containers. About 35% of the drinks' prices increase by 20p as approximately 35% of consumer do not return their containers. Under a variable rate scheme, in year 1, about 75% of drinks prices increase by 1p. 25% of drinks prices increase by either 20p, 40p, or 50p, depending on the size.

3.3 Scenario 2: all consumers believe that they will not return their containers

In this scenario, all consumers believe that they will not return their containers, so they see the deposit fee as a tax[13]. Based on evidence from other schemes this is unlikely but is used as a comparison to scenario 1.

The prices that *all* consumers pay increase by the full deposit fees:

- Under the flat rate scheme, the prices increase by 20p on all containers.
- Under the variable rate scheme, the prices increase by 20p on all small containers (500ml or less), 40p on medium containers (larger than 500ml and no greater than 1L), and 50p for larger containers (larger than 1L and no greater than 2L).

3.4 Scenario 3: all consumers believe that they will return their containers

In this scenario, all consumers believe that they will return their containers, so the price that they pay increases by 1p (the cost of effort) for each container. Again, this extreme scenario is unlikely but is used as a comparison to scenario 1.

In this scenario, the impact of the flat rate DRS is effectively the same as that of the variable DRS. This is because prices of all drinks increase by 1p in both the flat rate and variable rate scheme.

[13] Scenario 2 is equivalent to Scenario 1 but setting the return rate to 0%.

3.5 Scenario 4: all consumers are unsure whether they will return their containers.

In this scenario, all consumers are unsure whether they will return the container, so they perceive a portion of the deposit fee as a tax. The portion is modelled using the insights from behavioural economic theory.

Research in (DellaVigna, 2009) has shown that people generally prefer money now rather than later. However, they are willing to have the money later if they are compensated for the wait. To illustrate, the research shows that people prefer £1 now rather than in a month. Though they will take the money then if the amount they get will increase to £1.33[14]. This behaviour is known as present bias.

Consumers' present bias is modelled in this scenario. Under a flat rate DRS, consumers would rather have 20p today than later. They are willing to have the money later if they get 27p (20p times 1.33) in the future, however. The increased worth of the deposit fee over time cannot be compensated by the scheme. If and when they return the container, they only receive 20p back. The deposit fee therefore brings a net cost of 7p to the consumer. The same logic applies to other deposit fees. Consumers are willing to pay a 40p (or 50p) deposit today if they get 53p (or 67p) back in the future. As they can only get 40p (or 50p) back, the net cost is therefore 13p (or 17p).

The net costs are modelled as price increases. Therefore, in this scenario:

- Under the flat rate DRS, the prices of all containers increase by 7p.
- Under the variable rate DRS, the prices of small containers (500ml or less) increase by 7p, 13p on medium containers (larger than 500ml and no greater than 1L) and 17p on large containers (larger than 1L and no greater than 2L).

3.6 Demand sensitivity to final price changes

The scenarios determine the price changes, i.e. by how many pence will the price of the drink change. The model then needs to predict how the demand for drinks in different containers will change for every penny change in price.

In economics, a product's demand response to price changes can be estimated by using price elasticity. Price elasticity measures the percentage change in the demand for a product for every percentage change in price. For example, if the price elasticity of a product is -0.5 and price increases by 10%, the demand for the product decreases by 5% (-0.5 multiplied by 10%).

To model the change in demand for drinks in aluminium cans, two types of price elasticities are used:

- **Own price elasticity** estimates the percentage change in the demand for drinks in aluminium cans if the price of drinks in aluminium cans changes.

[14] To be precise, DellaVigna (2009) shows that the median person is indifferent between £15 today and £20 in the future. £20 is about 1.33 times greater than £15.

- **Cross price elasticity (of cans)** estimates the percentage change in the demand for drinks in aluminium cans if the price of drinks in PET changes.[15]

Both price elasticity effects are required to robustly estimate the change in demand. As deposit fees intercept the market, drinks in aluminium cans increase in price depending on the modelling scenario. This drives down the demand and is captured by the own price elasticity. At the same time, the same drinks in PET bottles also increase in price. Because these drinks are substitutes to the same drinks in cans, the demand for cans will rise (and vice versa). This is captured by the cross price elasticity.

Importantly, in the model, the difference in the impact that flat rate and variable rate deposit fees have on demand will be driven by the cross price elasticity.

Most cans in the model are small and are charged a 20p deposit. The price changes for drinks in cans in the flat rate and variable rate schemes are therefore largely the same[16]. Furthermore, the own price elasticity is the same in both schemes – demand for drinks in cans should be as sensitive to a 20p price change in the flat rate DRS as in the variable DRS. This means that the own price elasticity effect is the same in both schemes.

The cross price elasticity effect is different in the flat rate and variable rate scheme, however. Although demand for drinks in cans is equally sensitive to price changes in drinks in PET in both types of schemes, the price changes in the drinks in PET are different across schemes. For example, a large bottle will have a deposit of 20p under the flat rate scheme but 50p under the variable rate scheme. The 50p deposit on PET will increase the demand for drinks in cans more than the 20p deposit on PET. As a result, the difference in the impact of flat and variable schemes is determined by how the deposit fees on PET will change the demand for cans.

3.6.1 Estimates of elasticities

This section presents the elasticities estimated from the consumer survey conducted as part of this study. The survey is described in detail in Annex 2.

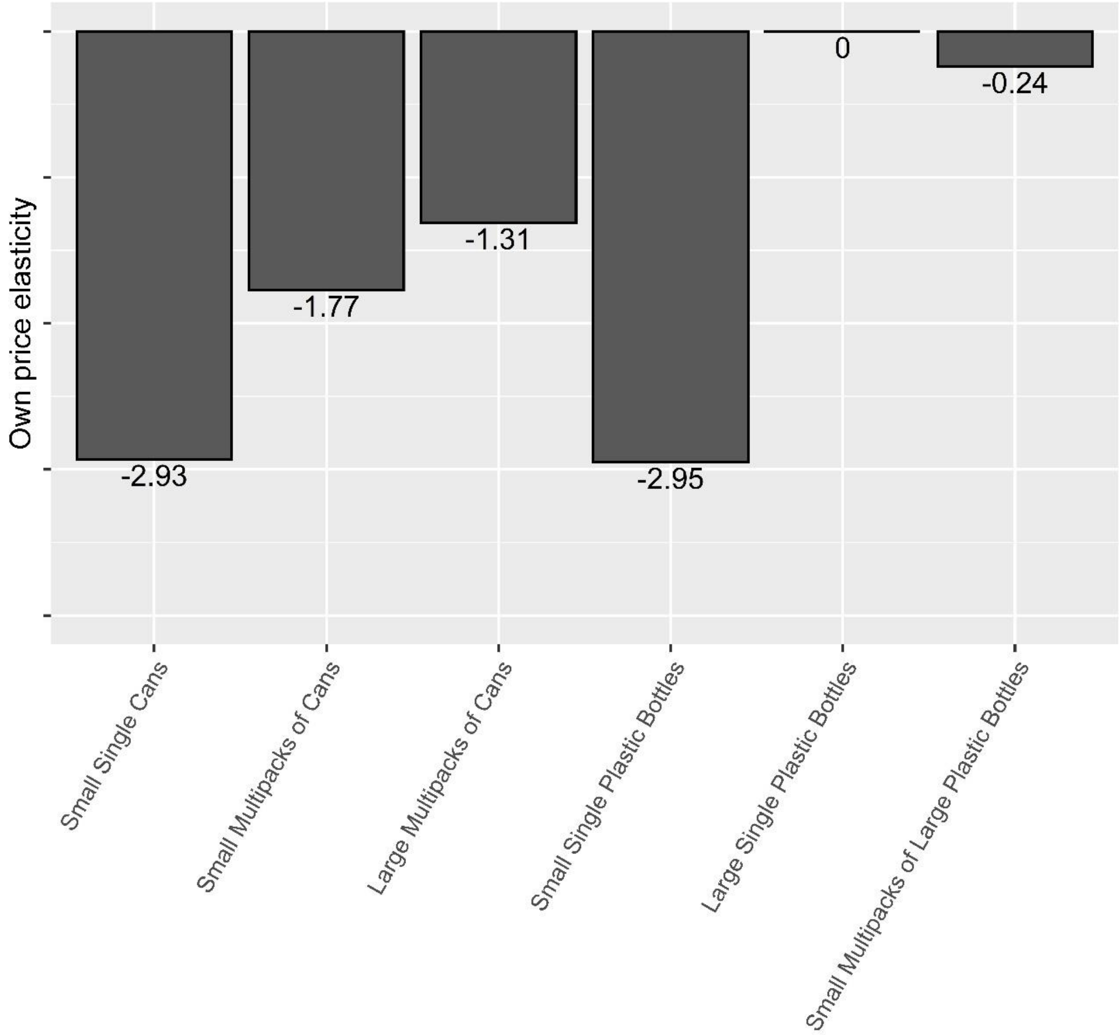
The model uses point estimates of elasticities. This means that it assumes a product's sensitivity to price does not change as quantity demanded changes. This is a simplification, necessary due to the scope of the study, as elasticities generally change along a product's demand curve.

[15] There is also a cross price elasticity of PET, which tells the model the percentage change in demand for drinks in PET if the price of drinks in cans change.

[16] A small number of cans are medium and large. That is why the price changes are not exactly the same.

Own price elasticities

Figure 7 Estimates of own price elasticity



Source: London Economics

Figure 7 presents the own price elasticity estimates from the consumer survey, which measure the percentage change in demand for every one per cent increase in the price of the product. These estimates capture the extent to which the demand for a product will fall because a deposit fee has made the product more expensive. It does not capture how demand will change because the deposit has also made other products more expensive.

Small sized drinks in cans and bottles are most sensitive to price. For every one per cent increase in the price of drinks in small single cans, the demand is estimated to decrease by 2.93%. For every one per cent increase in the price of drinks in small single plastic bottles, the demand is estimated to decrease by 2.95%. This is because smaller drinks have lower prices, so price changes are likely to come across as larger to consumers.

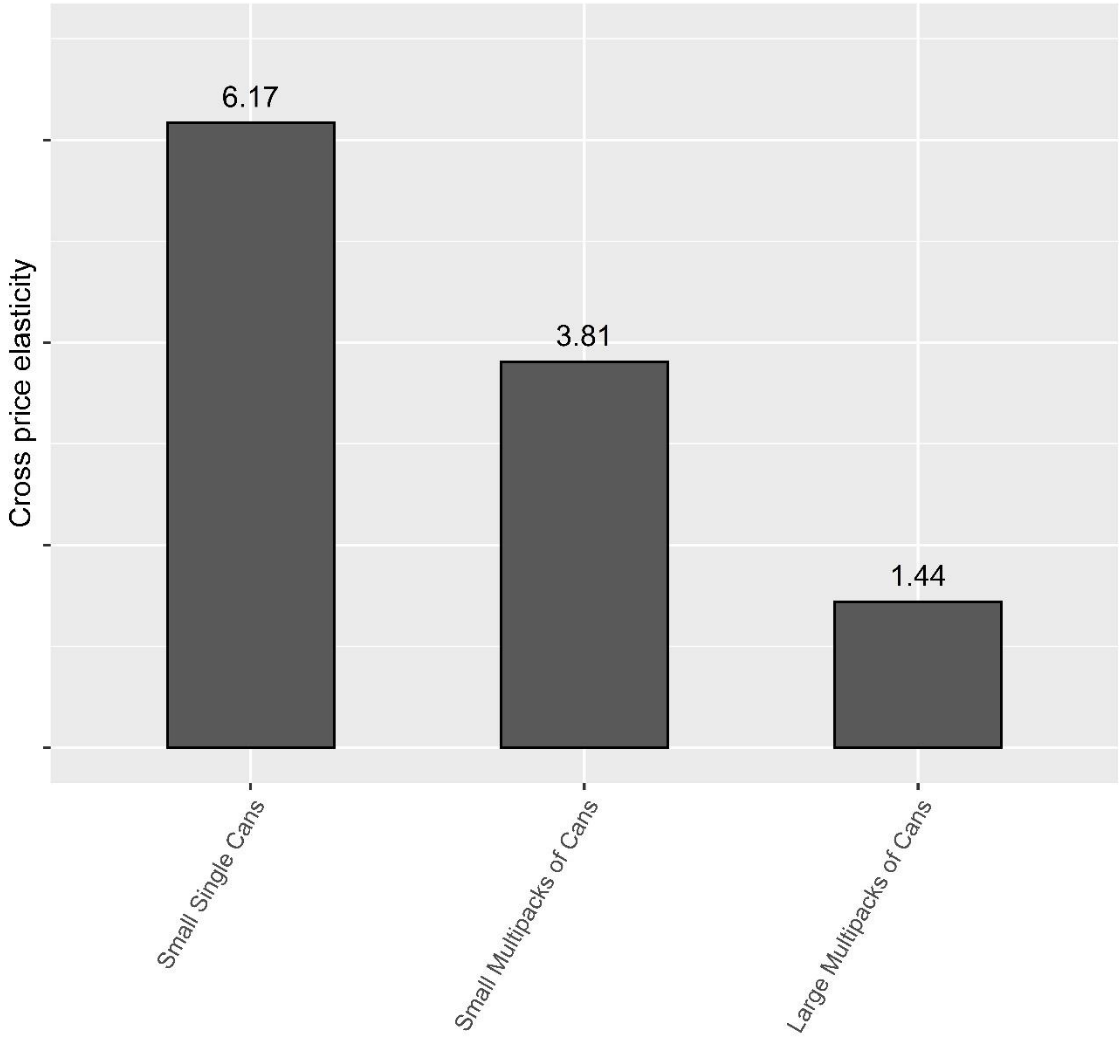
If the prices of small and large multipacks of cans increase by 1%, the demand for each product is estimated to decrease by 1.77% and 1.31% respectively.

If the price of small multipacks large plastic bottles increases by 1%, the demand is estimated to fall by -0.24%.

The own price elasticity of large single plastic bottles has been calibrated to zero. This is because own price elasticities are normally negative, and the uncalibrated estimate was positive. A positive own price elasticity means that as the product becomes more expensive, consumers have higher demand. This is unlikely to be true.

Cross price elasticities of cans

Figure 8 Estimates of cross price elasticities of cans



Source: London Economics

Figure 8 presents the cross price elasticities of cans. These estimate the percentage change in demand for drinks in cans if the price of the plastic substitute option increases. In other words, they capture the extent to which consumers are likely to switch from plastic to cans because the same drinks in plastic have also become more expensive.

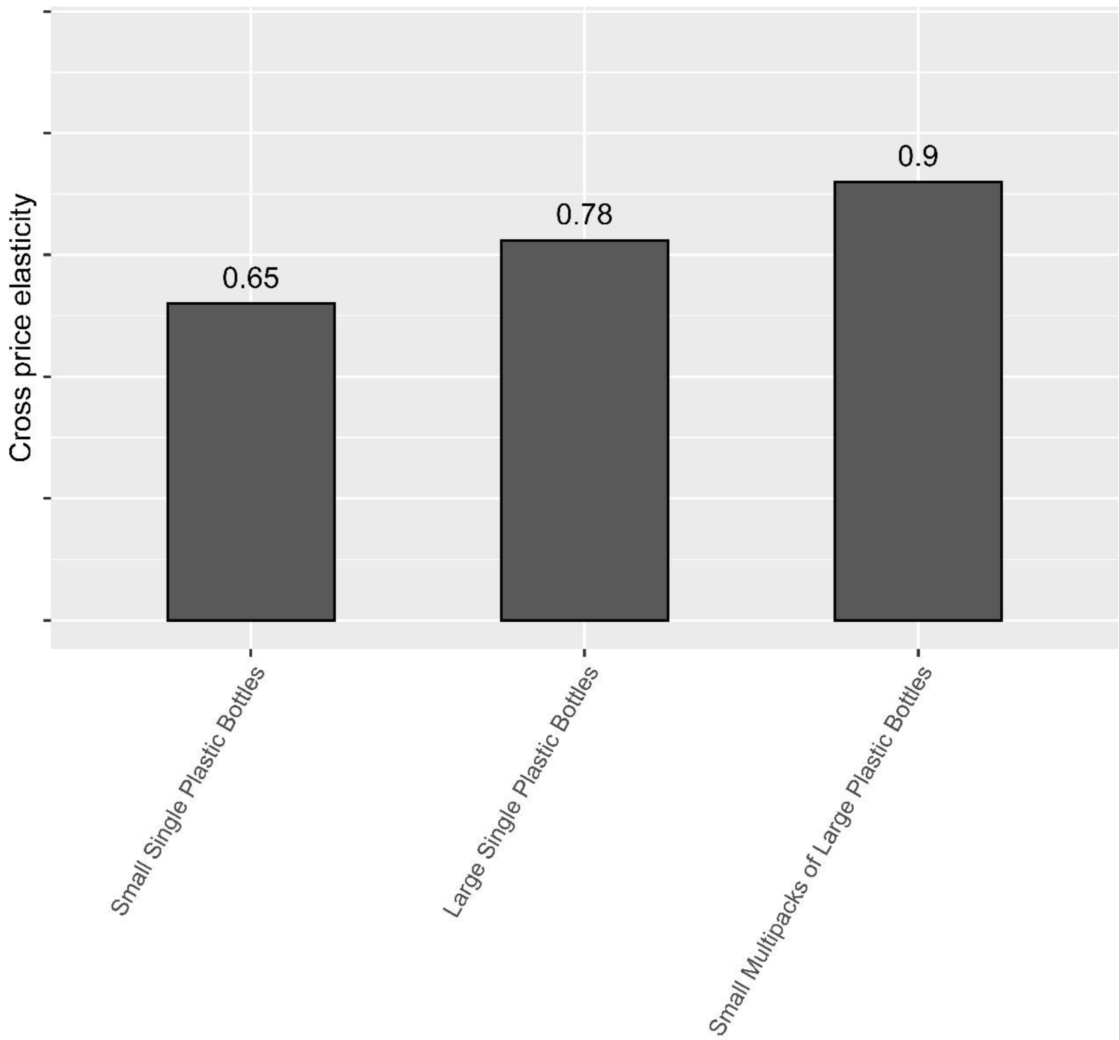
If the price of drinks in small PET bottles increases by 1%, the demand for the same drinks in small single cans are estimated to increase by 6.17%. Similarly, if the price of drinks in large PET bottles increases, the demand for the same drinks in large multipacks are estimated to increase by 1.44%.

The cross price elasticity of small multipacks of cans has been calibrated, to 3.81. This was necessary because the uncalibrated estimate was negative. A negative elasticity would have modelled that consumers would have a lower demand for the drinks in small multipacks of cans if the plastic substitutes become more expensive. This is unlikely to be true. The elasticity is most likely to be positive.

The calibration was based on the rest of the elasticities estimated from the survey. The rest of the elasticities of cans are all elastic, i.e. greater than 1 in absolute value (Figure 7 and Figure 8). The cross price elasticity of small multipacks of cans is therefore also likely to be elastic. In the absence of better evidence, it is assumed that the elasticity is likely to be somewhere between 1.44 and 6.17 – the cross price elasticities of small single cans and large multipacks. The model takes the midpoint, 3.81.

Cross price elasticities of plastic bottles

Figure 9 Estimates of cross price elasticities of plastic bottles



Source: London Economics

Figure 9 presents the cross price elasticities of plastic bottles. They estimate the percentage change in demand for drinks in plastic options if the same drinks in the can options become more expensive. The estimates capture the consumer demand that is likely to switch from cans to plastic. Note that the switching does not represent any additional fall in demand for cans. It represents the fall in demand from own price elasticity effects (Figure 7) that switches to plastic bottles.

For every percentage increase in price of drinks in small single cans, the same drinks in small single plastic options is estimated to increase in demand by 0.65%.

For every percentage increase in price of drinks in small multipacks of cans, the demand for the same drinks in large single plastic bottles is expected to increase in demand by 0.78%.

For every percentage increase in price of drinks in large multipacks of cans, the demand for the same drinks in small multipacks of large plastic bottles is expected to increase in demand by 0.90%.

Sense check

In order to check that this report's estimates are sensible, the elasticities estimated in the literature have been reviewed (Quirmbach et.al, 2018; Oxford Economics,2016; and HMRC, 2014). No elasticities exist in the literature that estimate the price sensitivity of demand for drinks in different packaging materials. The elasticities tend to be about types of drinks only, for example, elasticities of sweetened drinks and juice, making no reference to the package materials.

In the literature, the own price elasticities for soft drinks are typically in the range of -0.2 to -1.2. This report's estimates are higher, in the range of -0.24 to -2.95. This is considered reasonable because this report's elasticities are size specific. Small drinks are more likely to be sensitive to price changes due to their lower (starting) prices.

The own price elasticities of beer from the literature tend to be higher, however, centred around -1. Based on this observation, the own price elasticities of alcoholic drinks in this report are therefore calibrated to be 0.5 larger (in absolute terms) than the estimates from the survey.[17]

The cross price elasticities in the literature tend to be less than 0.3. This report's estimates are in the range of 0.65 to 6.17. This is again considered to be reasonable because this report's elasticities measure switching between the same drinks in different packaging materials. This type of switching is expected to be more sensitive to price than the switching between different drinks, which the elasticities in the literature measure.

As a further sense check, the estimates for own price elasticity and cross price elasticity were tested with two sector experts, Marcel Arsand, Head of Sustainability at Ball Beverage Packaging EMEA, and John O'Maoileoin, Group Global Sustainability Director at Can-Pack Group.

3.7 Demand change due to a DRS

This section presents the estimated change in demand for soft drinks in cans due to a DRS[18]. The change in demand for a drink in a can is calculated by:

4) the own price elasticity from section 3.6.1 multiplied by the percentage change in the price of the product; plus
5) the cross price elasticity from section 3.6.1 multiplied by the percentage change in the price of the drink in the plastic substitute option.

Therefore, the change in demand is estimated as the net effect between own price elasticity and cross price elasticity.

The pre-DRS prices are based on Nielsen 2019 market data, from which the percentage change in prices due to a DRS are added.

Figure 10, Figure 11 and Figure 12 below present the estimated change in consumer demand for cans.

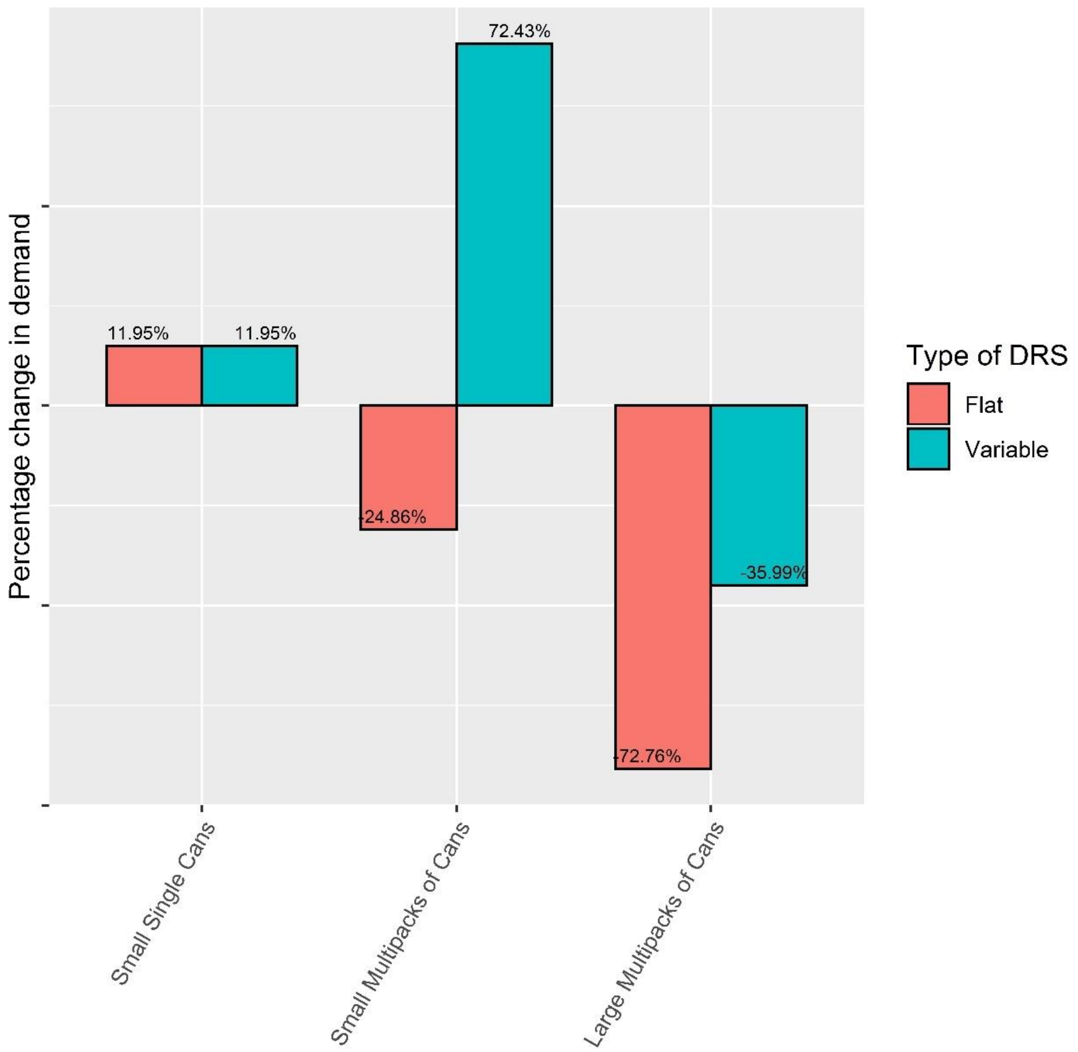
[17] The survey asked about soft drinks only due to limitations on the length of the survey that could be feasibly conducted.

[18] For changes in demand for alcohol see Annex 3

Deposit fee perceived as tax

In the model, consumers perceive the deposit fee as a tax if they know they will not return their containers. Some consumers perceive this in scenario 1 and everyone perceives this in scenario 2.

Figure 10 Change in demand if consumers perceive deposit fee as tax



Source: London Economics

For consumers with this perception, the demand for drinks in small single cans is estimated to increase by 12% in both the flat and variable rate DRS. The change in demand is the same because small cans are charged 20p deposit fees in both schemes.

The demand for drinks in small cans is very sensitive to the price of single plastic bottles. (Cross price elasticity is 6.17, Figure 8.) This is why even though 20p amounts to a larger percentage increase in the price of the can (32%) than the plastic bottle (17%) (Table 8), the demand for the can option still increases. In other words, the cross price elasticity effect overpowers the own price elasticity effect.

The demand for drinks in small multipacks of cans is estimated to decrease by 25% in the flat rate scheme and increase by 72% in the variable rate scheme. The difference is driven by the different deposit fees on plastic bottles across types of schemes.

In the flat rate scheme, drinks in large single PET bottles only increase in price by 17% (Table 8). In this situation the demand switch from PET to cans is small. In the variable scheme, however, drinks in large single PET bottles increase in price by 43%. In this case there is larger demand switch from PET bottles to small multi-packs of cans. The switch is large enough that it offsets the negative demand effect that the deposit fees have on the small multipacks of cans. The cross price elasticity effect again overpowers the own price elasticity effect.

The demand for drinks for large multipacks of cans is estimated to decrease by -73% in the flat rate scheme and -36% in the variable rate scheme. The difference is again driven the different deposit fees on plastic bottles across types of schemes.

The flat rate deposit increases the price of drinks in large PET bottles by 17%. In contrast, the variable rate deposit increases the price by 43%. The price increase in the variable DRS leads to more demand switch from PET to cans than the flat DRS. But this time, unlike the case of small multipacks of cans, the switch is not great enough to offset the negative demand effect the deposit fees have on cans. The cross price elasticity effect only partly offsets the own price elasticity effect. This is because demand for larger multipacks is less sensitive to the price of PET substitutes than smaller multipacks is to the price of PET substitutes (Cross price elasticity is 3.81 for small multipacks of cans and 1.44 for large multipacks of cans, Figure 8).

Table 8 Percentage change in price if consumers perceive the deposit fee as tax

Soft drinks in	Flat rate DRS (20p)	Variable rate DRS
small single cans	32.15%	32.15%
small multipacks of small cans	50.74%	50.74%
large multipacks of small cans	74.43%	74.43%
small single PET	17.19%	17.19%
large single PET	17.07%	42.67%
small multipack of large PET bottles[19]	17.07%	42.67%

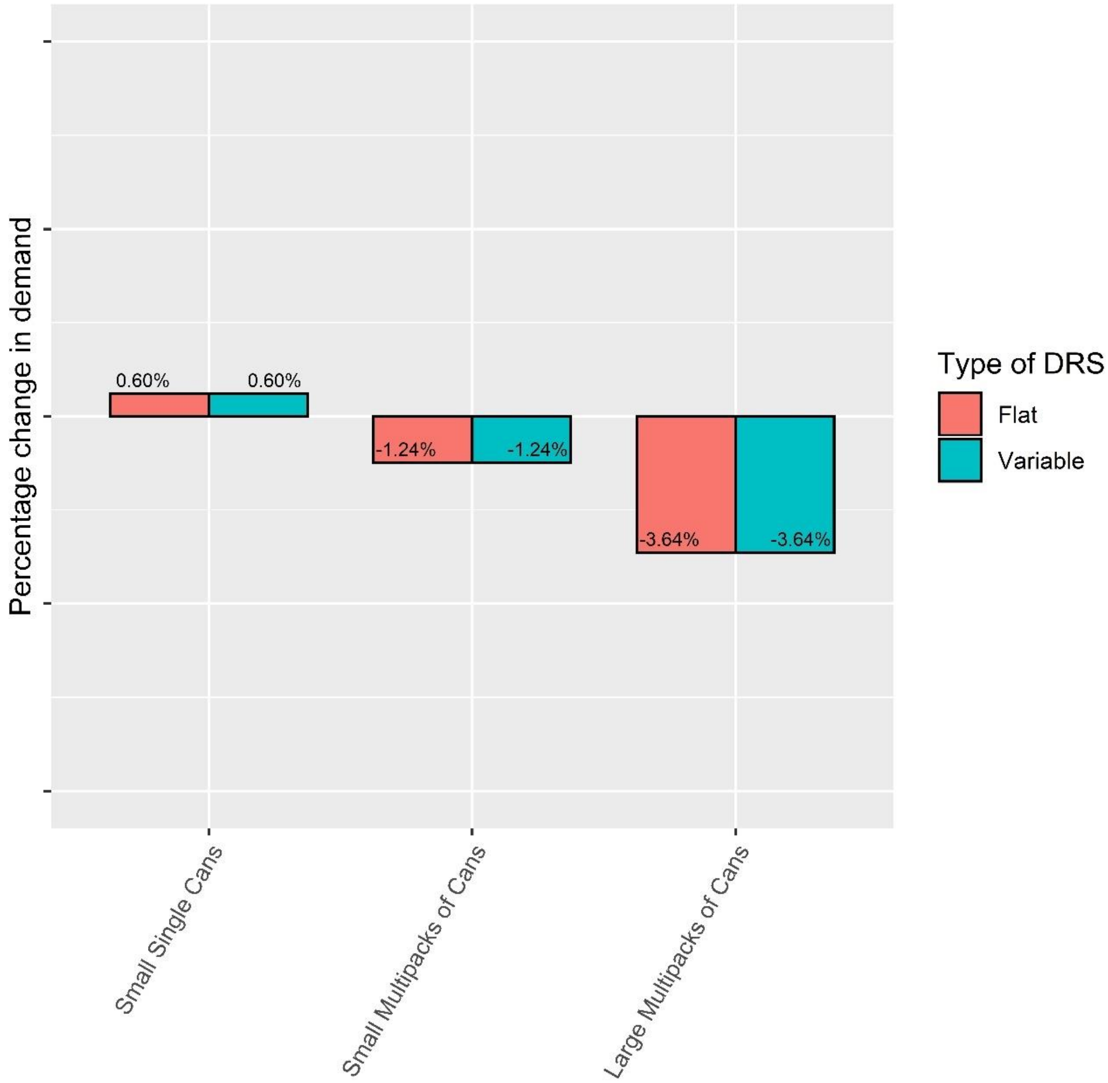
Source: London Economics

Price only increased by cost of effort

Consumers who return their containers will receive the deposit back and therefore only consider the cost of effort to return the container. In this case the price of the drink increases by the cost of effort only. This is the case for some consumers in scenario 1 and for all consumers in scenario 3.

[19] In the model we assume that a small multipack of large PET bottles costs the same as buying four single large PET bottles.

Figure 11 Change in demand if consumers only consider the cost of effort



Source: London Economics

The demand of consumers with this perception is estimated to change very little. The demand for drinks in single cans will not change by more than 4% (Figure 11). This is because the change in price due to the cost of effort is small in relative terms. Table 9 shows that the percentage increase in price is small for drinks in cans and PET.

The impact that the flat and variable rate scheme has on demand is also the same. This is because these consumers think they will not pay the deposit fees regardless of the type of scheme.

Table 9 Percentage change in price if consumers only consider the cost of effort

Soft drinks in	1p cost of effort changes price by
small single cans	1.61%
small multipacks of small cans	2.54%

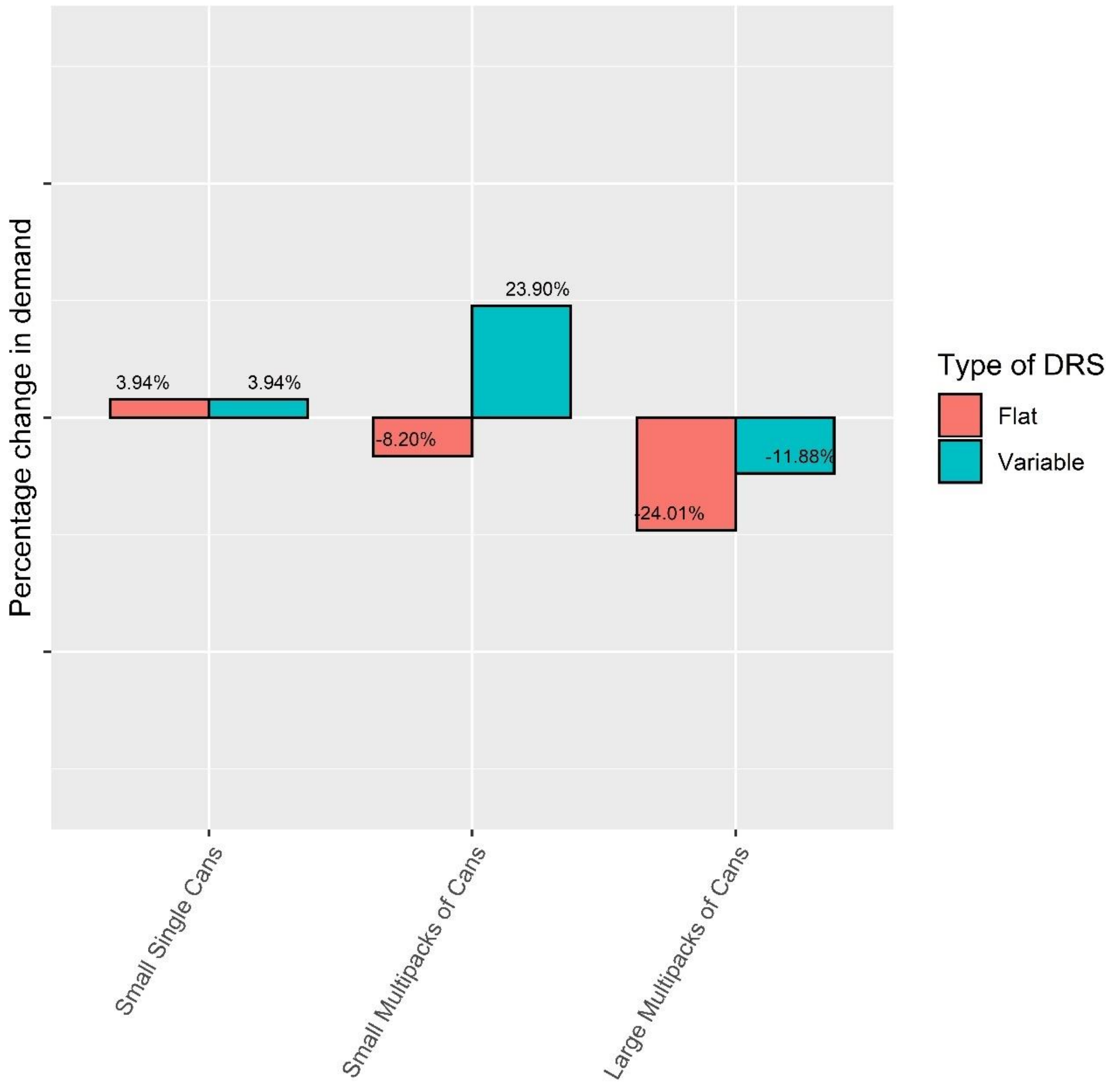
large multipacks of small cans	3.72%
small single PET	0.86%
large single PET	0.85%
small multipack of large PET bottles	0.85%

Source: London Economics

Portion of deposit fee perceived as tax

In the model, consumers perceive a portion of the deposit to be a tax if they are not sure whether they will return the containers. Everyone in scenario 4 perceives the deposit fee in this way.

Figure 12 Change in demand if consumers perceive portion of deposit fee as tax



Source: London Economics

The impact that a DRS has on the demand of these consumers is similar to the consumers who see the deposit fee as a tax, but the impact is smaller. This is because the prices increase by a portion of the deposit fees only.

The demand for drinks in small multipacks of cans is estimated to fall by -8% in the flat rate scheme. Demand for small multi packs of cans is estimated to increase by 24% in the variable rate scheme. In the variable scheme the price of the large single PET bottle increases by 14% and the price of a small multipack increases by 17%. Nevertheless, the estimated cross price elasticity (3.81, Figure 8) means that consumers' demand switches away from PET towards multipacks of cans.

The demand for drinks in large multipacks of cans is estimated to decrease by 24% in the flat rate scheme and 12% in the flat rate scheme. The demand for larger multipacks of cans is less sensitive to the price of PET substitutes than the demand for small multipacks of cans. The price increase in the PET option leads to positive demand for the can option. But it is not enough to offset the negative demand impact that deposit fees have on the cans. The cross price elasticity only partly offsets the own price elasticity effect.

Table 10 Percentage change in price if consumers perceives portion of deposit fee as tax

Soft drinks in	20p deposit fee changes price by	Variable rate deposit fee changes price by
small single cans	10.61%	10.61%
small multipacks of small cans	16.74%	16.74%
large multipacks of small cans	24.56%	24.56%
small single PET	5.67%	5.67%
large single PET	5.63%	14.08%
small multipack of large PET bottles	5.63%	14.08%

Source: London Economics

3.8 Return rates

After the elasticities are estimated, the model can then predict the percentage change in demand for every penny change in price in scenarios 2, 3 and 4. For scenario 1, the return rates are needed. A2.1.2 describes the survey questions used to estimate return rates

Table 11 Estimated return rates by deposit fee level and container size

Deposit per container	Return rate for small containers	Return rate for medium containers	Return rate for large single container	Overall
£0.10	57.9%	57.4%	57.6%	57.6%
£0.20	65.4%	64.2%	64.0%	64.6%
£0.30	72.1%	71.6%	71.8%	71.9%
£0.40	76.7%	77.0%	77.2%	76.9%
£0.50	82.0%	82.3%	82.1%	82.1%

Source: London Economics

Table 11 presents the estimated return rates that the model uses. The flat rate DRS puts 20p on all containers. Therefore, the flat rate scheme in the model is estimated to achieve a 64.6% return rate in year 1.

The variable rate scheme uses 20p, 40p and 50p. The scheme is therefore estimated to attain 65.4% return rate for small containers (500ml or less), 77.0% for medium containers (larger than 500ml and up to 1L), 82.1% for larger containers (larger than 1L and up to 2L). This gives an overall return rate of 74.8% in year 1 in the variable rate scheme[20].

Return rates are not constant over time in the model, however. Findings from sections 2.2 and 2.3 suggest that 1) return rates are likely to rise over time as the scheme matures, and 2) both flat and variable rate DRSs have the potential to reach 90% return rate or above. The model therefore projects the following return rates.

Table 12 Projected return rates

	Year 1	Year 2	Year 3	Year 4	Year 5
Flat rate DRS	64.6%	77.3%	90.0%	90.0%	90.0%
Variable rate DRS	74.8%	89.6%	90.0%	90.0%	90.0%

Source: London Economics

The growth in return rate is based on the target return rates in the Scottish DRS. The Scottish scheme assumes a 70% target rate in year 1, 80% in year 2 and 90% in year 3 and thereafter. These rates imply an annual growth rate of 19.7% in year 2, which the model applies on the return rates in year 1 in both the flat and variable rate DRS. The return rate thus increases to 77.3% in flat rate scheme and 89.6% in variable rate schemes in year 2. In year 3, the return rates in both flat and variable rate schemes are set to 90%, based on the finding that both types of schemes can attain 90% return rate or above.

3.9 Key points

- The return rates under a variable rate DRS in the first two years exceed those observed under a flat rate DRS. They stabilise at 90% in the third year for both types of DRS.
- Under a flat rate DRS charging a 20p deposit fee, the prices of drinks in aluminium cans increase more in relative terms than the same drinks in PET bottles.
- Consumers' demand for drinks can depend on how they perceive the deposit fee and their propensity to return their containers. This study uses four different modelling scenarios to capture those varying demand responses.
- For those who do not return the containers, the prices that they pay are increased by the full deposit fees. For those who do return the containers, the prices they pay increase by a cost of effort at 1p per container.
- Own price elasticities are used to estimate the percentage change in the demand for drinks in cans if the own price of drinks in cans changes. Cross price elasticities are applied to estimate the percentage change in the demand for drinks in cans if the price of drinks in PET changes, which is used in this study to assess the degree of material switching between packaging types that could happen under different DRS designs. The difference in the impact that flat rate and variable rate deposit fees have on demand is driven by the cross price elasticity.
- If consumers perceive the deposit fee as a tax:

[20] The overall return rate is not used in the variable scheme calculations. Individual return rates by container size are used instead.

- The demand for drinks in small single cans is estimated to increase by 12% in both the flat and variable rate DRS;
- The demand for drinks in small multipacks of cans is estimated to decrease by 25% in the flat rate scheme and increase by 72% in the variable rate scheme. Higher deposit fees for large PET bottles under a variable rate DRS lead to consumers switching to multipacks of cans.
- The demand for drinks for large multipacks of cans is estimated to decrease by -73% in the flat rate scheme and -36% in the variable rate scheme. The difference is driven by more consumers switching from PET to multipacks under a variable rate DRS.

4 Economic impact of DRS

4.1 Overview of model

Using the estimated change in demand from section 3, the model estimates the economic impact of a DRS on the UK aluminium can production industry.

The economic impact of a DRS is estimated by comparing a flat and variable rate DRS to the no-DRS baseline. The indicators of impact are:

- Total units of cans sold;
- Revenue of can producers, and;
- Gross valued added

The indicators are assessed over a 5-year period. Year 1 is based on 2019 data on the UK off-trade carbonated soft drinks, beer and cider markets reported by Statista (see more section 4.2). Year 2 and onwards are based on 2020-2023 data projected by Statista.

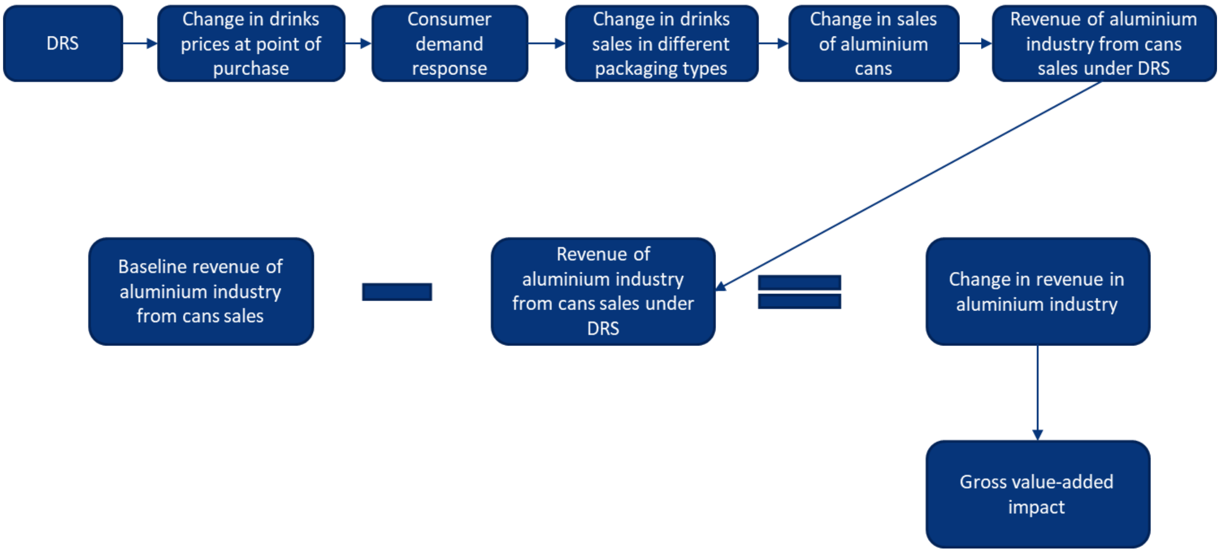
Figure 13 illustrates the overall logic of the model. The DRS changes drinks prices at the point of purchase. Demand for drinks then changes depending on the scenario. The sales of drinks in aluminium cans are then affected.

The model assumes that if a can of drink is not sold, the aluminium industry also does not generate sales revenue from that can[21]. Therefore, the change in sales of drinks in aluminium cans corresponds to a change in sales of aluminium cans. Moreover, the model assumes that aluminium can producers' production capacity is fixed across the years. If the demand for cans decreases in one year but increases in the next year, can producers can supply a sufficient number of cans to satisfy the increased demand in the subsequent year i.e. they do not decrease their production to match the lower demand from the first year.

Using the sales of aluminium cans, the model estimates the revenue that the aluminium can industry earns under the DRS.

[21] This is a simplifying assumption. In practice, aluminium can producers may sell cans to the drinks producers regardless of how many canned drinks are sold in the end. In essence, the model assumes that a) the demand for canned beverages equals their supply b) that the supply of canned beverages (in units) equates to the canned beverages producers' demand for cans (i.e. beverage producers require the same amount of empty cans as the quantity of canned beverages they offer to retailers) c) the demand for empty cans equates to their supply.

Figure 13 Overview of model logic



Source: London Economics

As the second row of Figure 13 shows, the model then calculates the difference between sales of cans under the no DRS scenario and the DRS scenario. This reveals the change in the number of aluminium cans sold and the change in aluminium can producer revenue due to the DRS.

The change in revenue is then used to calculate the corresponding change in the aluminium can production industry's GVA, to better understand the wider economic impact of the scheme.

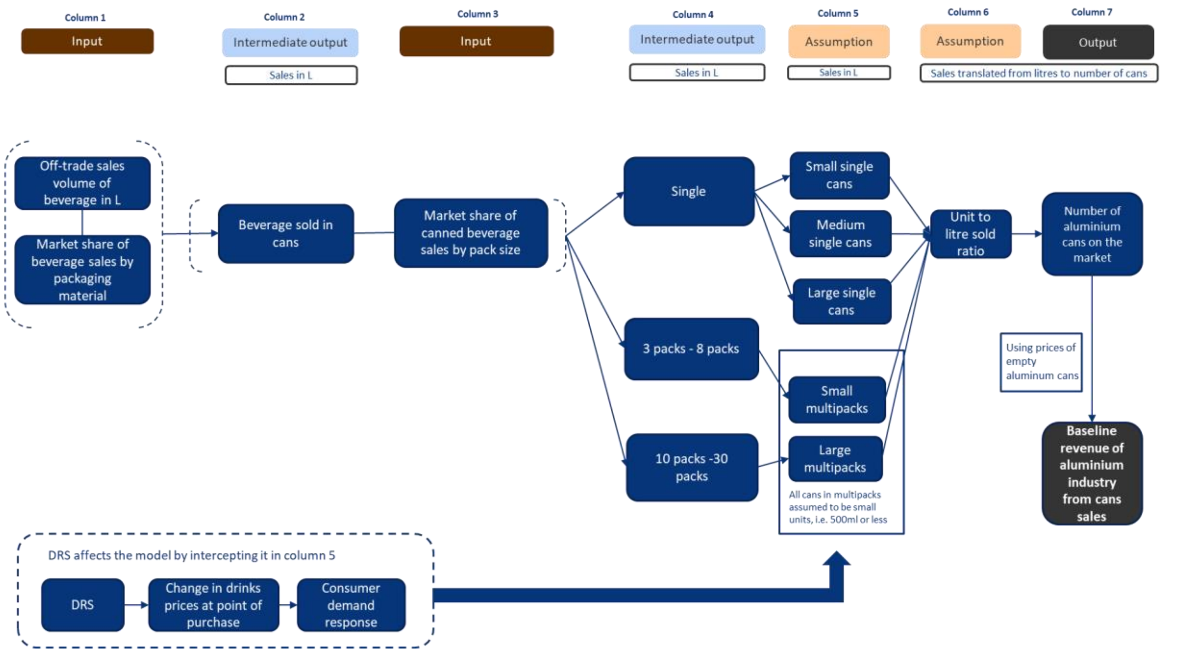
4.2 No-DRS baseline

This section explains the estimation of the no-DRS demand for cans[22]. Figure 14 sets out the modelling logic. Each estimation step is presented in columns 1 to 7.

The model makes use of different estimation components, as shown in the top row in the figure. Inputs are fed into the model in the form of raw data. Some inputs are combined into intermediate outputs, from which further calculations are made. The model also makes several assumptions to define the scope for calculations. The final output of the model gives the baseline sales of aluminium cans, in terms of units sold and revenue.

[22] The no-DRS baseline demand estimation for PET and glass can be found in Annex 4.

Figure 14 No DRS baseline logic



Source: London Economics

- **Columns 1-2:** The model starts by estimating the total off-trade UK sales volume (in litres) of drinks sold in aluminium cans for carbonated soft-drinks[23,24], beer[25] and cider[26]. As this data is not directly available, the information on the overall off-trade sales volume is collected. This data is then combined with the market share of drinks sales volume by packaging material, separately for carbonated soft drinks[27] and alcohol[28]. The litres of drinks sold in cans are then estimated.
- **Columns 2-4:** Using the market share of canned drinks by pack size, the canned drinks sales are further split into single cans and multipacks of different pack sizes[29], separately for soft drinks[30] and alcohol[31].
- **Columns 4-5:** The single cans sales are grouped into sales of small, medium, and large single containers based on the sales volume (in litres) distribution found in Nielsen data, separately for soft drinks and alcohol. Containers less than 500ml are classified as small,

[23] Statista Consumer Market Outlook. Carbonated Soft Drinks, United Kingdom (2020)

[24] Non-carbonated soft drinks are excluded as only a marginal share of those drinks are sold in aluminium cans. According to Statista data, in the UK in 2018, only 1.6% of fruit juice was sold in "glass/other", which may include cans, and none of bottled water was sold in cans.

[25] Statista Consumer Market Outlook. Beer, United Kingdom (2020)

[26] Statista Consumer Market Outlook. Cider, Perry & Rice Wine, United Kingdom (2020). It was impossible to distinguish cider data from perry and rice wine, however, based on the Westons Cider Report, according to which UK consumers consumed approximately 529 million litres of cider in 2018, we assume that cider makes up the vast majority of the 'Cider, Perry & Rice Wine data'.

[27] Carbonated soft drinks packaging in the United Kingdom (2018) based on the British Soft Drinks Association Annual Report

[28] Take-home beer and cider by pack type share of volume sold based on The Can Makers Report 2016. The data was further extracted for lager beer (representing 85% of beer sales) and cider based on The Can Makers Report 2016.

[29] The pack sizes are 3 pack, 4 pack, 6 pack, 8 pack, 10 pack, 12 pack, 14-23 pack, 24 pack and 30 pack.

[30] Carbonated soft drink cans share of pack sales in the United Kingdom 2016 based on The Can Makers UK Market Report 2016.

[31] Canned beer and cider sales share in the United Kingdom 2015, by pack size, based on The Can Makers UK Market Report 2016.

between 500 and 999ml are classified as medium, and 1000ml or more are classified as large. The multipacks of cans are grouped into small and large multipacks. Packs which contain 8 or less cans are classified as small packs. Packs which contain between 10-30 cans are classified as large packs.

- **Columns 6-7:** So far, drinks sales have been presented in litre terms. To estimate the number of units of aluminium cans (which is needed for estimating can producers' revenue), the sales volume in litres needs to be converted into unit terms. Nielsen drinks sales data in volume in litres and units sold is combined to calculate the unit-to-litre ratios. The model assumes that, on average, to purchase one litre of drink consumers need to buy between 3.4 cans of soft drinks and 2.3 cans of alcohol in small cans down to 0.5 cans for large cans (for both soft drinks and alcohol). Using these unit-to-litre ratios, the sales volumes in litres are translated to sales volume in number of cans[32].
- **Column 7:** The number of aluminium cans in different sizes is then multiplied by the price of empty aluminium cans, which is assumed to be 5p each for all cans. The revenue for years 2-5 has been adjusted for the future inflation using the CPI inflation forecast by the International Monetary Fund (Office for Budget Responsibility, 2020) and discounted using the 3.5% discount rate. This gives the baseline estimate of the aluminium industry's revenue from cans sales in 2019 discounted prices.

The bottom row in Figure 7 illustrates how the DRS intercepts the baseline. The implementation of the DRS changes drinks prices at the point of purchase. Depending on the scenario, the demand for drinks changes. The sales of drinks in cans in column 5 will then change according to the price elasticities (see more Section 3.6). The sales of aluminium cans will then change.

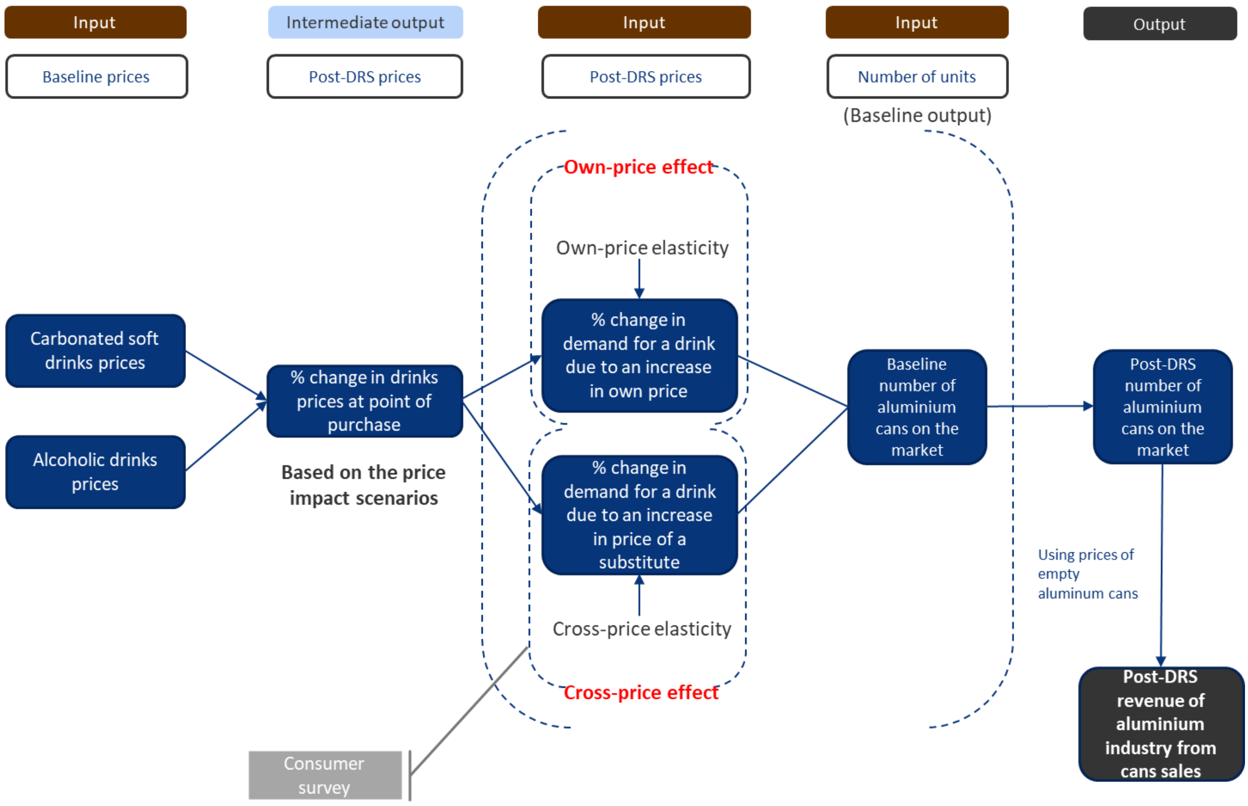
4.3 Introduction of a DRS

This section details the estimation steps of the post-DRS revenue of can producers (the 'post-DRS scenario). Figure 15 summarises the key calculation steps for the post-DRS demand for cans estimation[33].

[32] All cans in multipacks are assumed to be small (i.e. 500ml or less). This follows the observation that most cans in multipacks are in 330ml.

[33] The same modelling logic has been applied to estimate the post-DRS demand for PET.

Figure 15 Post-DRS modelling logic



Source: London Economics

- **Column 1:** The model calculates the changes in drinks prices due to a DRS.
- **Column 2:** The percentage changes in the prices of drinks post-DRS are calculated for the four scenarios described in sections 3.2 (Scenario 1), 3.3 (Scenario 2), 3.4 (Scenario 3) and 3.5 (Scenario 4). Table 5 shows an illustration of average prices paid for soft drinks in the UK, how these prices change post-DRS and finally, what percentage change in price does a flat deposit fee of 20p constitute for each packaging format.
- **Column 3-4:** The model is then able to estimate the percentage change in the demand for drinks in aluminium cans in scenarios 1-4. First, the own and cross-price elasticities are estimated based on the consumer survey. A detailed explanation of how these are estimated can be found in section 3.6. Then, the overall percentage changes in demand for each packaging format can be found, as detailed in section 3.7 and Annex 3. In the final step, the model combines the percentage changes in demand for each packaging format with the relevant baseline quantities of aluminium cans in the market pre-DRS (estimated following the steps explained in section 4.2) to predict the post-DRS demand.
- **Column 5:** The number of aluminium cans post-DRS is then multiplied by the price per empty can of 5p, the same as in the baseline. This gives the post-DRS revenue of can producers. The revenue for years 2-5 has been corrected for the future inflation using the CPI inflation forecast by the International Monetary Fund (Office for Budget Responsibility, 2020) and discounted using the 3.5% discount rate.

4.4 Modelling caveats

There are several caveats which must be considered when interpreting this study's results. These are:

- **Post-DRS demand estimates rely on point estimates of price elasticities.** Due to the absence of more accurate measures in the economic literature and limitations in scope, this study estimates own and cross price elasticities for cans and PET based on responses to a consumer survey. Nevertheless, these estimates have to be treated as the best available proxies, as they estimate *point elasticities* based on one specific change in price (e.g. 50p increase in the price of a PET bottle). This means this research assumes that demand sensitivity to price is constant or linear. In other words, if demand is estimated to decrease by x% for a 1% increase in price, it is assumed that a 5% increase in price will decrease demand by 5 times x% and a 60% increase in price will decrease demand by 60 times x%. However, elasticity in reality would be expected to change along the length of a demand curve and to therefore not be linear.
- **Own and cross price elasticities for cans drive the difference in the economic impact of a flat and variable DRS on the can production industry**. In both the flat and variable DRS, each single can is charged a 20p deposit. Therefore, the change in demand for single cans that occurs because own price has changed (own price elasticity) is the same across both schemes. However, each large PET bottle is charged 20p in a flat rate DRS but 50p in a variable DRS. The change in demand for cans that occurs because the plastic substitute's price has changed (cross price elasticity) is therefore different across the schemes.

  As described in section 3.6.1 the model takes the cross price elasticity between demand for a large single PET bottle and a small multipack of cans as 3.8. This means that that the analysis estimates that the demand for small multipacks of cans decreases by 24.9% in the flat rate DRS and increases by 72.4% in a variable rate scheme, as shown in Figure 10, section 3.7.

  As stated in section 3.6.1, there is no data to our knowledge that provides estimates of cross price elasticity between drink packaging types and therefore the only source of this information comes from the consumer survey conducted as part of this study. If indeed these cross price elasticities are different to those estimated from the consumer survey, then the economic impact will be different. For example, if the cross price elasticity between a large PET bottle and a small multipack of cans was 1 (instead of 3.8) then demand for small multipacks of cans is estimated to decrease by 72.7% in flat rate scheme (instead of 24.9%) and decrease by 47.1% in the variable rate scheme (instead of increasing by 72.5%). This illustrates how sensitive the impact of a DRS is to cross price elasticities.

  This means that if the cross price elasticities are lower than that estimated by the consumer survey the difference between the flat and variable rate schemes will also be smaller. Furthermore, the different between the variable rate scheme and the no DRS baseline will be larger.

- **Several own and cross price elasticities for cans (and PET) have been calibrated.** Whenever the estimated elasticities did not conform with economic theory (i.e. own price elasticities were positive and cross-price elasticities were negative), they were imputed.

- **Glass bottles post-DRS demand is not estimated based on own and cross price elasticities.** Due to this study's limited scope, the consumer survey did not contain questions needed to estimate own and cross price elasticities for glass bottles. Therefore, the post-DRS demand for glass is assumed to equal the demand under no-DRS baseline scenario (see more A5.2.1) rather than the more detailed demand change forecasts, as was done for cans and PET. It is therefore possible, that in reality there could be deviations to the estimated post-DRS demand for glass bottles.

- **The modelling only considers direct impacts of a DRS.** The estimated economic impact of a flat and variable rate DRS on the UK economy is limited to the aluminium can production industry only. The estimation of the economic impacts of the scheme on other industries (e.g. recycling industry, PET and glass bottles production industries) is not within the study scope.

4.5 Modelling results

This section presents the key modelling outputs for the no-DRS baseline, flat rate and variable rate DRS scenarios. Two indicators of DRS impact are assessed: total sales volume in units sold and revenue of can producers. The results are presented for aluminium cans unless indicated otherwise. Annex 5 presents the modelling results for PET and glass bottles which are used in the DRS financing model explained in section 5.1.2.

4.5.1 No-DRS baseline results

As detailed in Table 13, under the no-DRS scenario, the model predicts that there will be 46.8 billion aluminium cans sold in the UK over a 5 year time period (approx. 9.4 billion units per year). Small multipacks of cans of up to 8 cans per pack will generate the largest cans sales (20.1 billion, 42.9%), followed by large multipacks of between 10 to 30 cans per pack (18.2 billion, 38.9%) and small single cans (8.4 billion, 17.9%). Medium and large single cans represent only a small share of the total sales (0.3% altogether).

Table 13 Sales volume under no-DRS baseline scenario (million units sold, over a 5 year time period)

	Small single cans	Medium single cans	Large single cans	Small multipacks of cans	Large multipacks of cans	Total
Carbonated soft drinks	8,001.19	0.00	0.00	11,587.93	8,001.19	**27,590.30**
Beer	356.58	106.37	0.10	7,070.22	8,484.27	**16,017.54**
Cider	71.28	21.26	0.02	1,413.35	1,696.02	**3,201.94**
Total	**8,429.05**	**127.63**	**0.13**	**20,071.50**	**18,181.47**	**46,809.78**

Source: London Economics' calculations based on data from Statista and Nielsen and reports published by the British Soft Drinks Association and The Can Makers.

Table 14 shows the estimated revenue of aluminium can producers for the same period. The total net present value of the revenue in today's prices over a 5 year time period is estimated to be £2.1 billion (approx. £420 million each year).

Table 14 Revenue of can producers under no-DRS baseline scenario (£ millions, real discounted value in 2019 prices, over a 5 year time period)

	Small single cans	Medium single cans	Large single cans	Small multipacks of cans	Large multipacks of cans	Total
Carbonated soft drinks	360.41	0.00	0.00	521.97	360.41	**£1,242.79**
Beer	16.04	4.78	0.00	318.03	381.63	**£720.49**
Cider	3.21	0.96	0.00	63.69	76.43	**£144.29**
Total	**£379.66**	**£5.74**	**£0.01**	**£903.69**	**£818.47**	**£2,107.57**

Source: London Economics' calculations based on data from Statista, Nielsen and IMF and reports published by the British Soft Drinks Association, The Can Makers and HM Treasury. The estimates were adjusted for inflation based on IMF CPI forecasts and discounted using the 3.5% HM Treasury discount rate.

4.5.2 Post-DRS results

This section summarises the modelling outputs for the post-DRS scenarios 1 to 4. Each scenario compares the results of a flat DRS, variable DRS and the no-DRS baseline.

Post-DRS demand for Scenario 1: all consumers know whether they will return their containers

Figure 16 illustrates that under Scenario 1, where the non-returning consumers perceive the deposit as an implicit tax and the returning consumers incur only the cost of effort, can sales volume under a variable rate DRS is approximately 6% (2.5 billion units) larger than under a flat rate scheme over a 5 year period. Moreover, the variable rate DRS leads to a similar number of cans sold to the quantity estimated for the no-DRS baseline scenario (1.6% decrease in sales as compared to the baseline).

Figure 16 Sales volume under no-DRS, flat rate and variable rate DRS in Scenario 1 (million units sold, over a 5 year time period)

Source: London Economics' calculations based on the baseline estimates from Table 13, relative change in demand estimates shown in section 3.7 and return rates from Table 12 in section 3.8.

Figure 17 presents can producers' revenue. A flat rate DRS is estimated to lead to a reduction of £117.38 million (approx. £23.5 million per year) compared to a no-DRS, while the variable rate scheme is estimated to lead to a reduction of £32.46 million.

Figure 17 Revenue of can producers under no-DRS, flat rate and variable rate DRS in Scenario 1 (£ million, real discounted value in 2019 prices, over a 5 year time period)

Source: London Economics' calculations based on the baseline estimates from Table 13, relative change in demand estimates shown in section 3.7 and return rates from Table 12 in section 3.8. The estimates were adjusted for inflation based on IMF CPI forecasts and discounted using the 3.5% HM Treasury discount rate.

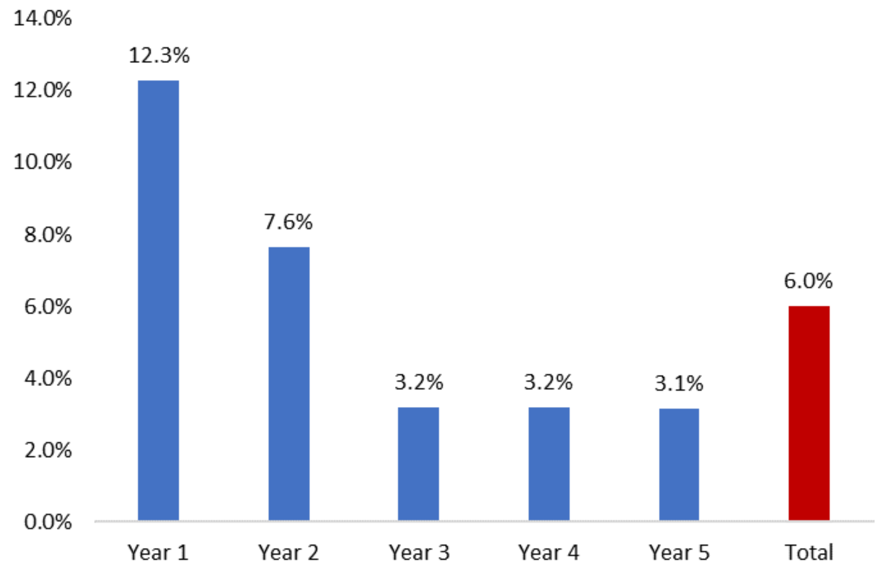
The difference between can producers' sales and revenue for a flat and variable rate DRS is not constant across the years. As shown in Figure 18, in the first year of a DRS, the revenue and sales generated under the variable rate DRS scenario are 12.3% higher than those generated under the flat rate DRS. I.e., the difference between the two schemes is twice the size at the start of the scheme relative to the end of the 5 year period. This corresponds to 1 billion more cans sold (approx. 10% of annual total sales under no-DRS) and £50 million of additional revenue for can producers in year 1 under a variable rate DRS compared to a flat rate DRS.

In the second year, a significant difference between the two schemes still holds, decreasing to 7.6%. This represents over 650 million more cans sold and £31 million of additional revenue for can producers in year 2 under a variable rate DRS compared to a flat rate DRS. Starting from the third year, as the return rates for both types of DRS reach their maximum of 90%., the difference between the two decreases and stabilises at 3.2% per year.

It is important to note that one of the underlying assumptions in the modelling of the DRS impact is that can producers' capacity to supply enough cans to meet consumer demand is unconstrained i.e. can producers are always able to produce a sufficient number of cans each year and adjust their production levels to match the demand, no matter how large the demand fluctuations are. Therefore, in line with this assumption, a decrease in demand of more than 10% in the first year of a DRS running, does not affect can producers' supply in the subsequent years.

An assessment of can producers' responsiveness and sensitivity to demand fluctuations is beyond this study's scope, however, it is possible that the decrease in demand in year 1 may lead to a contraction in supply. If this was the case the difference between the variable and flat rate DRS may not stabilise at 3.2% from year 3 onwards. However, this assessment is beyond the scope of this study.

Figure 18 Percentage difference in can producers' revenue and sales for a variable DRS compared to a flat DRS over 5 years (variable vs. flat difference as % of flat)

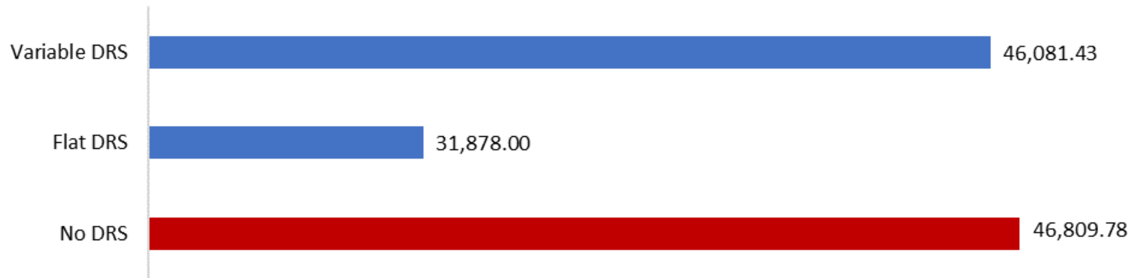


Source: London Economics' calculations

Post-DRS demand for Scenario 2: all consumers believe that they will not return their containers

For the second price impact scenario, the results show the largest gap between the flat and variable rate DRS of 14.2 billion units (approx. 44.6%). At the same time, the variable rate DRS is estimated to provide a similar level of sales as the no-DRS scenario (approx. 1.6% lower).

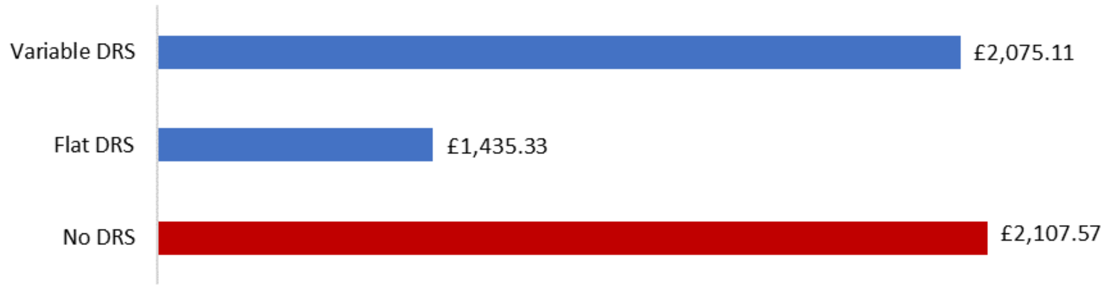
Figure 19 Sales volume under no-DRS, flat rate and variable rate DRS in Scenario 2 (million units sold, over a 5 year time period)



Source: London Economics' calculations based on the baseline estimates from Table 13, relative change in demand estimates shown in section 3.7 and return rates from Table 12 in section 3.8.

Figure 20 illustrates the difference between the two types of DRS using the measure of can producers' revenue. Can producers would earn £639.8 million more under a variable rate DRS than under a flat rate DRS (compared to a no-DRS baseline) if all consumers treated the deposit fee as non-refundable.

Figure 20 Revenue of can producers under no-DRS, flat rate and variable rate DRS in Scenario 2 (£ million, real discounted value in 2019 prices, over a 5 year time period)



Source: London Economics' calculations based on the baseline estimates from Table 13, relative change in demand estimates shown in section 3.7 and return rates from Table 12 in section 3.8. The estimates were adjusted for inflation based on IMF CPI forecasts and discounted using the 3.5% HM Treasury discount rate.

Post-DRS demand for Scenario 3: all consumers believe that they will return their containers

In scenario 3, consumers only incur the additional cost of effort of 1p per container on top of the drink's price at point of purchase. As a result, the post-DRS demand for drinks is the same regardless of the type of DRS. Moreover, under this scenario, the overall demand is least affected as the change in price is marginal. As Figure 21 and Figure 22 show, the total number of units sold and can producers' revenue post-DRS (both flat and variable rate) are anticipated to be approximately 1.6% lower than the no-DRS baseline equivalents.

Figure 21 Sales volume under no-DRS, flat rate and variable rate DRS in Scenario 3 (million units sold, over a 5 year time period)

Source: London Economics' calculations based on the baseline estimates from Table 13, relative change in demand estimates shown in section 3.7.

Figure 22 Revenue of can producers under no-DRS, flat rate and variable rate DRS in Scenario 3 (£ million, real discounted value in 2019 prices, over a 5 year time period)

Source: London Economics' calculations based on the baseline estimates from Table 13 and relative change in demand estimates shown in section 3.7. The estimates were adjusted for inflation based on IMF CPI forecasts and discounted using the 3.5% HM Treasury discount rate.

Post-DRS demand for Scenario 4: all consumers are unsure whether they will return their containers

Under the fourth scenario, where all consumers incur the additional cost associated with their present bias i.e. consumers value their money more now than in the future, the model predicts that the variable rate DRS will lead to sales 11.2% higher than the flat rate DRS (approx. 4.7 billion units difference). Moreover, the variable rate DRS will marginally reduce sales of cans relative to the no-DRS baseline scenario (0.5% difference).

Figure 23 Sales volume under no-DRS, flat rate and variable rate DRS in Scenario 4 (million units sold, over a 5 year time period)

Source: London Economics' calculations based on the baseline estimates from Table 13 and relative change in demand estimates shown in section 3.7.

In financial terms, the revenue of can producers for a variable rate DRS exceeds the revenue under a flat rate DRS by £211.2 million. The difference in revenue between the variable and no-DRS baseline stands at £10.7 million over the 5 year time period.

Figure 24 Revenue of can producers under no-DRS, flat rate and variable rate DRS in Scenario 4 (£ million, real discounted value in 2019 prices, over a 5 year time period)

Source: London Economics' calculations based on the baseline estimates from Table 13 and relative change in demand estimates shown in section 3.7. The estimates were adjusted for inflation based on IMF CPI forecasts and discounted using the 3.5% HM Treasury discount rate.

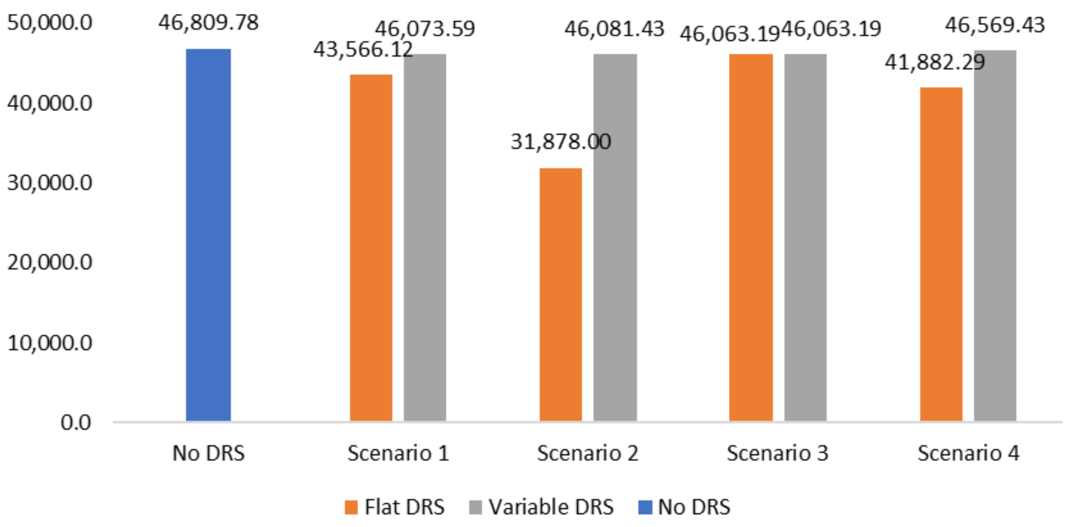
All four scenarios: comparison

Figure 25 and Figure 26 show the modelling results for all four scenarios. In each chart, the results for a flat and variable rate DRS can be compared with the no-DRS scenario (blue bar).

Results for both types of DRS show identical patterns for both impact indicators, total sales and can producers' revenue.

All of the DRS scenarios imply reductions in sales relative to the no-DRS baseline scenario. Nevertheless, for all four modelling scenarios, the variable rate DRS sales and revenues are never lower than 1.6% below the baseline. On the contrary, the same indicators are impacted to a greater extent under the flat rate scenario compared to the no-DRS scenario (lower by 7%, 32% and 11% compared to the baseline for scenarios 1, 2 and 4 respectively).[34]

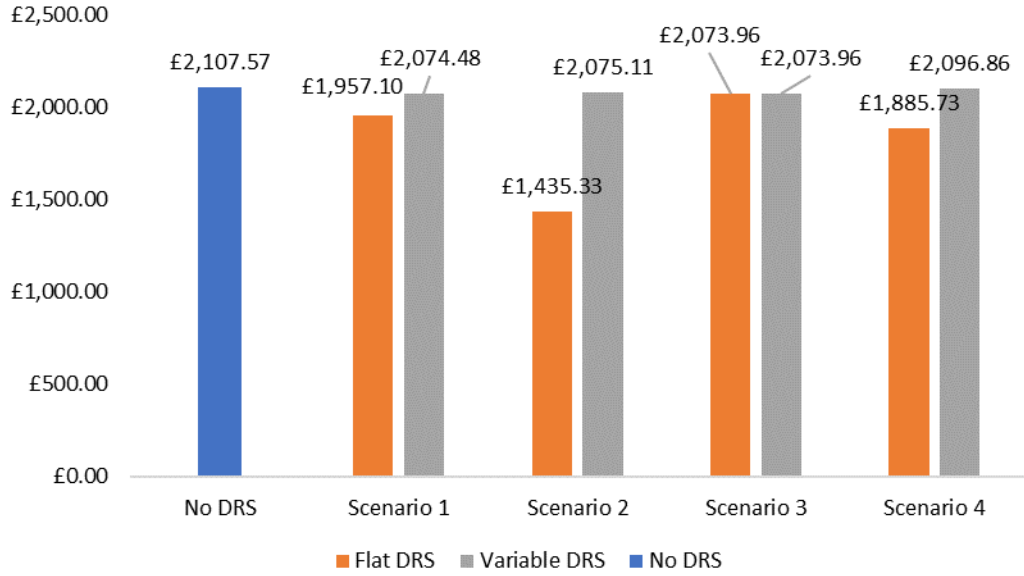
Figure 25 Sales volume under no-DRS, flat rate and variable rate DRS across four modelling scenarios (million units sold, over a 5 year time period)



Source: London Economics' calculations based on the baseline estimates from Table 13 and relative change in demand estimates shown in section 3.7.

[34] As set out in section 4.4, if the cross price elasticities between PET and cans is lower than that estimated by this study then the difference between the variable and flat rate DRS will be smaller.

Figure 26 Revenue of can producers under no-DRS, flat rate and variable rate DRS across four modelling scenarios (£ million, real discounted value in 2019 prices, over a 5 year time period)



Source: London Economics' calculations based on the baseline estimates from Table 13 and relative change in demand estimates shown in section 3.7. The estimates were adjusted for inflation based on IMF CPI forecasts and discounted using the 3.5% HM Treasury discount rate.

Table 15 presents the change in total units of cans and PET bottles sold under a flat and variable rate DRS by scenario.

Table 15 Change in total units of PET and cans sold by DRS type

Scenario	Total *plastic* bottles sold in the market over 5 years (in millions)	Difference in plastic bottles sold relative to baseline (%)	Difference in plastic bottles sold relative to baseline (in million units)	Total *cans* sold in the market over 5 years (in millions)	Difference in cans sold relative to baseline (%)	Difference in cans sold relative to baseline (in million units)
No DRS baseline	53,341	0.00%	0	46,810	0.00%	0
Flat rate DRS: scenario 1 - everyone knows whether they will return	52,934	-0.76%	-407	43,566	-6.93%	-3,244
Flat rate DRS: Scenario 2 - everyone believes they will not return	51,467	-3.51%	-1,874	31,878	-31.90%	-14,932
Flat rate DRS: scenario 3 - everyone believes they will return	53,247	-0.18%	-94	46,063	-1.59%	-747
Flat rate DRS: scenario 4 - everyone is unsure about whether they will return	52,722	-1.16%	-618	41,882	-10.53%	-4,927
Variable rate DRS: scenario 1 - everyone knows whether they will return	51,838	-2.82%	-1,503	46,074	-1.57%	-736
Variable rate DRS: scenario 2 - everyone believes they will not return	44,637	-16.32%	-8,704	46,081	-1.56%	-728
Variable rate DRS: scenario 3 - everyone believes they will return	53,247	-0.18%	-94	46,063	-1.59%	-747
Variable rate DRS: scenario 4 - everyone is unsure about whether they will return	50,468	-5.38%	-2,872	46,569	-0.51%	-240

Source: London Economics' calculations based on Statista, Nielsen and Defra (2019) data.

The PET production market is less affected than the can production market for each modelling scenario under a flat rate DRS. The decrease in units of PET on the market is between 0.18% and 3.51% of compared to the baseline. Total units of cans on the other hand is estimated to decrease by 1.6%-31.9% relative to the baseline. In particular, in scenario 1, total units of PET decrease by less than 1% (-0.76% relative to baseline) whereas total units of cans decrease by almost 7% relative to baseline for cans.

For a variable rate DRS, total units of PET decrease by between 0.18% and 16.3%, whilst the can market is less affected with a reduction of in total units of 0.5% to 1.6%. However, in absolute terms, the sales of PET exceed those of cans. Owing to the larger unit value of the DRS for a large PET container under a variable rate scheme, consumers are more likely to purchase a multipack of cans than under the flat rate scheme, where each container has the same deposit fee.

4.6 Effects on gross value added

This report translates the impact of a flat or variable rate DRS on the change in sales of empty aluminium cans to gross value added (GVA) terms.

As the economic impacts on other industries are out of study scope, the GVA impact estimated in this report is limited to the aluminium can production industry only (i.e. indirect and induced effects associated with a UK DRS are not evaluated).

4.6.1 Effect on GVA

The change in sales of empty aluminium cans estimated in section 4.5.2 are also the changes in output that a flat and variable rate scheme would bring to the UK. This is because output measures the value of *all* new goods and services produced in an economy. The changes in GVA are different, as GVA only measures the value of *final* goods and services.[35]

To convert the impact in GVA terms, the GVA-to-output ratio[36] from the 2014 UK Input-Output tables published by the Office for National Statistics (ONS)[37] is calculated. The ratio is calculated using the total GVA and output figures for ‘Fabricated metal products, excl. machinery and equipment and weapons & ammunition’ industrial category. This ratio is used to proxy for the aluminium can production industry, as the ratio specific to that industry is not available. For every pound change in the sales (output) of empty aluminium cans, it is therefore assumed that the UK GVA will change by £0.21.

Figure 27 presents the estimates the change in GVA over 5 years due to the DRS, for all four consumer demand/behaviour scenarios.

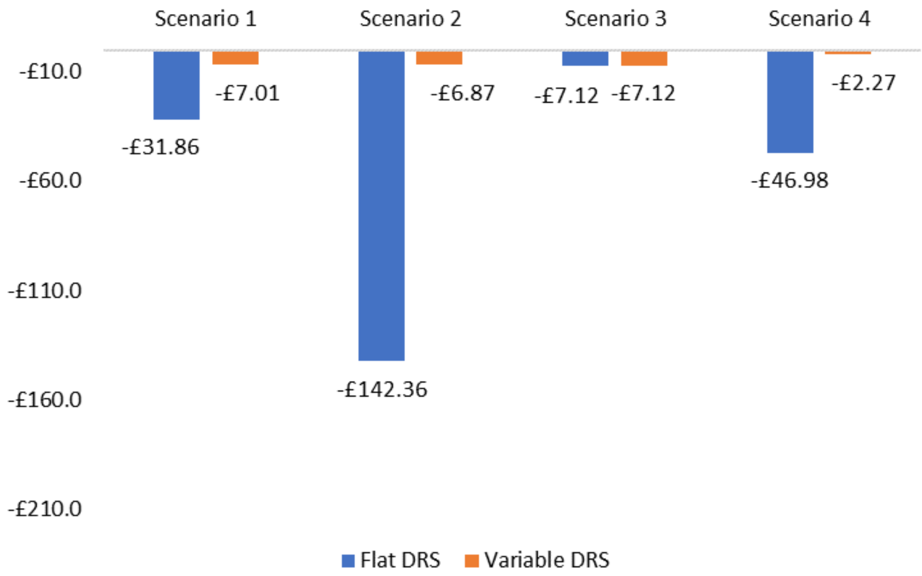
On average under a variable rate DRS, GVA decreases in a range between £2.27 and £7.12 million. The decrease is larger for a fixed rate DRS, with the decrease in GVA ranging between £142.4 million and £7.12 million.

[35] Applying the Office for National Statistics definition (2018), GVA represents the value of the can production industry’s outputs decreased by the value of intermediate inputs used in the production process such as the output generated by the manufacturers of virgin or recycled aluminium.

[36] GVA-to-output ratio = Total GVA in a given industry / Total output in a given industry

[37] https://www.ons.gov.uk/economy/nationalaccounts/supplyandusetables/datasets/ukinputoutputanalyticaltablesdetailed

Figure 27 Decrease in GVA compared to no-DRS baseline (£ million, over a 5 year time period)



Source: London Economics' calculations based on the ONS 2014 UK input-output tables

4.7 Key points

- The study estimated the economic impact of a flat and variable rate DRS by comparing it to the no-DRS baseline scenario. The impact is measured over a 5 year period using total units of cans sold, revenue of can producers and change in GVA.
- There are several caveats which must be considered when interpreting the study's results.
- The model predicts that under the no-DRS scenario there will be 46.8 billion aluminium cans sold in the UK over a 5 year time period (approx. 9.4 billion units per year). Small and large multipacks of cans will generate 82% of the overall cans sales.
- Under no-DRS, the total net present value of the revenue in today's prices over a 5 year time period is estimated to be £2.1 billion (approx. £420 million each year).
- Under post-DRS scenario 1, can sales volume under a variable rate DRS is approximately 6% (2.5 billion units) larger than under a flat rate scheme over a 5 year period. The variable rate DRS leads to a similar number of cans sold to the quantity estimated for the no-DRS baseline scenario (1.6% decrease in sales as compared to the baseline).
- The difference between can producers' sales and revenue for a flat and variable rate DRS is not constant across the years. In the first year, there are 1 billion more cans sold and £50 million of additional revenue for can producers under a variable rate DRS (12.3% difference). In the second year, the variable rate DRS sells 650 million more cans and generates £31 million of additional revenue for can producers in year 2 under a variable rate DRS compared to a flat rate DRS. Starting from the third year, the difference stabilises at 3.2% per year.
- There are more PET than cans sold for each modelling scenario under both types of DRS. The can production industry is less affected under a variable rate DRS.

5 Other impacts of DRS

5.1 DRS financing

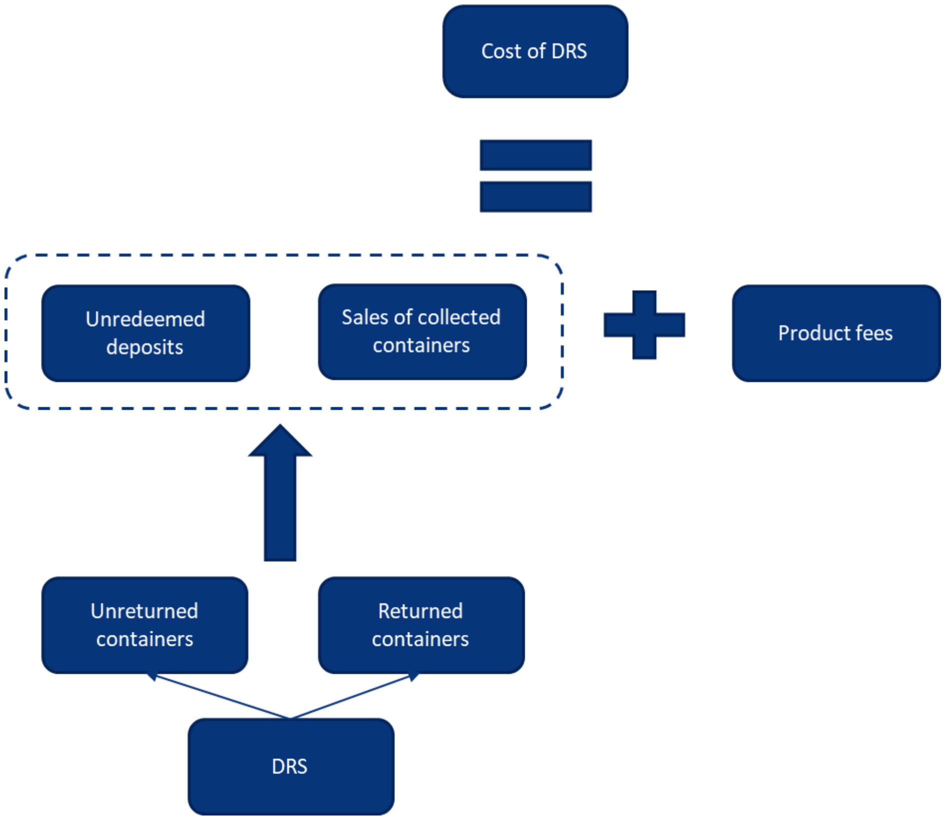
A DRS in the UK could be financed differently depending on whether a flat or variable rate is implemented. This section examines the differences in financing options between a flat and variable scheme.

5.1.1 Funding sources in a DRS

Generally, a DRS is likely to be financed by three key sources (Figure 8):

- **Unredeemed deposits**. Some drinks containers are not returned. These unredeemed deposits go into financing the scheme.
- **Sales of collected containers**. The returned containers are owned by the scheme operator, who sells the materials as recyclates. These proceeds finance the scheme.
- **Product fees**. Drinks producers pay a fee for each container that they put on the market. The fees levels are set by the scheme operator and pay towards the cost of collection and recycling.

Figure 28 General principal of DRS financing



Source: London Economics

In the UK, the scheme operator will be not-for-profit (Defra, 2019). Therefore, if a DRS does not raise enough funds from unredeemed deposits and selling collected containers, the operator has to raise product fees. The drink containers in the system may differ between a flat and variable rate scheme. This would impact the financing of the scheme from these revenue sources and in turn the product fees required to break even.

5.1.2 Modelling methodology

The model uses the cost of implementing and running a UK DRS and estimates the DRS revenue from unredeemed deposits, sales of collected containers and product fees. The estimates are provided for both flat and variable rate DRS.

The total annual cost of a DRS is based on Defra (2019). The model estimates that 7% more cans will become in scope of the DRS than Defra does. This is because the data source that both the model and Defra use for PET and glass containers is WRAP (2019). However, the data source that the model uses for cans is Statista, whereas Defra uses WRAP (2019). The model's higher estimate of cans has been sensed checked using Alupro's sector knowledge. Therefore, in order to accommodate for the estimated increase in volume the model scales up Defra's cost estimates by 7%. This is an estimate based on the assumption that if the DRS has to process more containers the cost of processing also increases. The adjusted costs used in the model are presented in Table 16.

Table 16 Annual cost of DRS (in millions, £)

Total cost	Year 1	Year 2	Year 3	Year 4	Year 5
Low estimate	£1,068.64	£860.25	£860.25	£860.25	£860.25
Central estimate	£1,087.87	£869.87	£869.87	£869.87	£869.87
High estimate	£1,109.25	£879.49	£879.49	£879.49	£879.49

Note: The original cost figures have been increased by 7% to match the higher estimates of can sales used in the model compared to the cans sales figures used by Defra (WRAP, 2019).
Source: Defra (2019). 'Introducing a Deposit Return Scheme on beverage containers'. Retrieved 5 October 2020 from
https://consult.Defra.gov.uk/environment/introducing-a-deposit-return-scheme/supporting_documents/depositreturnconsultia.pdf

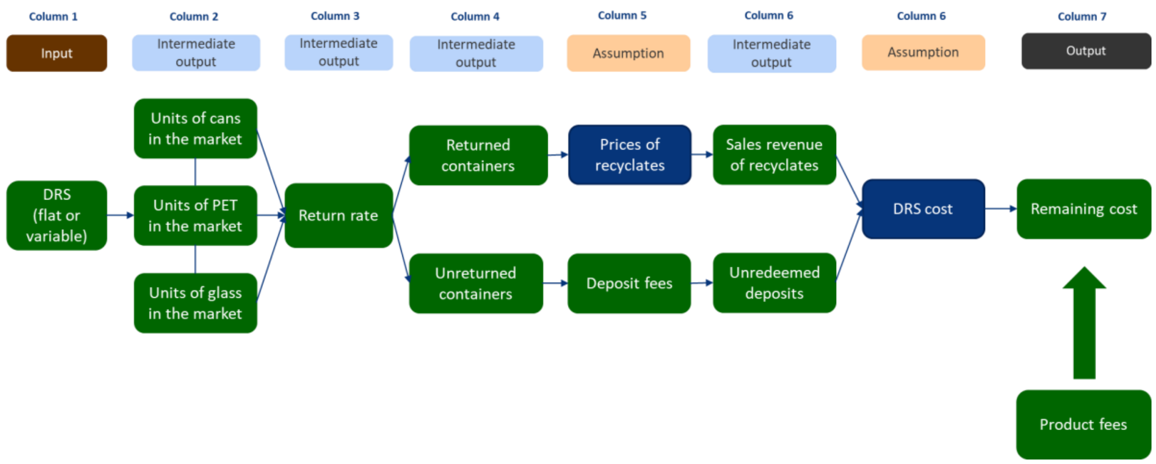
The cost is assumed to be the same under a flat and variable rate scheme. The first year of the scheme is expected to have a higher cost because of the initial set up. This includes construction and set up of counting centres, as well as labelling of drinks containers[38].

As the scheme operator is run as not for profit, the model therefore assumes that it earns no annual profits. This means that in the model the scheme raises revenue exactly equal to the overall cost every year. The scheme is also assumed to raise *all* its revenue through the three sources: unredeemed deposits, sales of collected containers, and product fees. If the revenue from one source changes, the revenue from the rest of the sources must adjust to offset the change. However, the DRS operator only has direct control over one source, the level of product fees.

Figure 29 presents the modelling logic. The boxes in green indicate elements in the model that change depending on whether the scheme is flat or variable rate.

[38] A label would present the DRS information of the container, such as whether the container is in scope of the DRS or not.

Figure 29 DRS financing - modelling logic



Source: London Economics

- **Columns 1-2**: The DRS determines the number of drinks containers for each packaging material in the market[39]. The number of cans, PET bottles, and glass bottles in the market under a flat rate scheme may be different from a variable rate scheme. This is because the flat and variable DRS may lead consumers to choose drinks in different packaging materials.
- **Columns 3-4:** Using the return rate, the model estimates the number of containers that will be returned and unreturned under a flat and variable rate scheme. The return rate may be different across both types of schemes (see more in section 3.8).
- **Columns 4-6:**
  - **Returned containers:** The returned containers are collected and sold by the DRS operator. As recyclates are sold by weight, the number of returned containers is used to calculate their weight in tonnes. This is done using the average weight of containers by size and packaging material in tonnes (Table 17). Recyclates are then sold at prices per tonne. The prices of recyclates used in the model are based on the monthly recyclates prices in the UK between January and September 2020 found at *letsrecycle*[40] (Table 18). The prices from *letsrecycle* are increased by 5%. The adjustment is made to reflect that the quality of material recovered through DRS would likely be better than

[39] As explained in Section 4.1 in more detail, the model uses the total units of beverages sold in different containers (i.e. units of beverages sold by beverage producers to retailers) as a proxy for the total units of beverages consumed in the market (i.e. units of beverages purchased by consumers from retailers).

[40] The monthly prices of clear PET, coloured PET, aluminium, amber glass, clear glass and mixed glass between January and September 2020 are available on letsrecycle (at the time of research). Each material has a monthly minimum and maximum price. For example, aluminium was worth as little as £680.00 per tonne and as much as £705.00 per tonne in September 2020.

To calculate the price of aluminium in Table 18, firstly, the average minimum price between January and September is calculated, so is the average maximum price in the same period. The median of the average minimum and maximum prices is the price in Table 18.

As the model does not distinguish between clear and coloured PET, the prices of clear and coloured PET need to be aggregated. The price of PET in Table 18 is the median of four prices: average minimum price of clear PET, average maximum price of clear PET, average minimum price of coloured PET, and average maximum price of coloured PET.

Similarly, the prices of amber glass, clear glass and mixed glass are aggregated. The price of glass in Table 18 is the median of six prices: average minimum price of amber glass, average maximum price of amber glass, average minimum price of clear glass, average maximum price of clear glass, average minimum price of mixed glass, and average maximum price of mixed glass.

kerbside recycling.[41] This is because, unlike kerbside recycling, DRS collection would only contain drinks containers made of PET, aluminium, and glass.

Table 17 Average weight of a container in tonnes, by material and size

Container size	PET	Can	Glass bottles
Small	0.000027	0.000012	0.000235
Medium	0.000026	0.000020	0.000413
Large	0.000043	0.000000	0.000480

Note: Small = less than 500ml. Medium = 500-749ml. Large = 1000ml or more. The average weights of containers were calculated based on the units and tonnes of packaging materials sold in the UK in 2017.

Source: London Economics analysis based on WRAP (2019) 'Drinks Recycling On-the-Go'. Retrieved 26 October 2020 from https://wrap.org.uk/sites/files/wrap/OTG%20Drinks%20Containers%20Final%20Report%20ENG017-012.pdf

Table 18 Prices of recyclates per tonne

Material	Price per tonne (unadjusted)	Price per tonne (adjusted by +5%)
PET	£133.33	£140.00
Aluminium	£701.94	£737.04
Glass	£12.28	£12.89

Source: London Economics analysis based on prices on letsrecycle https://www.letsrecycle.com/prices/

- □ **Unreturned containers:** the number of unreturned containers is used to calculate the amount of unredeemed deposits. In the flat rate scheme, all containers have a deposit fee of 20p. In the variable rate scheme, small containers have a deposit fee of 20p, medium containers, 40p and large containers 50p.

- **Columns 6-7:** The sales of recyclates and unredeemed deposits contribute towards the financing of the DRS. Any remaining scheme costs are financed through revenue from product fees.

Modelling approach for the revenue from product fees

The revenue from product fees is modelled to vary by material. This is based on the product fees found in other countries (Table 7). The fees tend to be different across packaging materials because it is often more costly for schemes to support some materials than others.

The costs associated with collection and transport are material specific. For example, collecting glass requires more space and labour because glass bottles are not crushed at collection points. Furthermore, some materials have higher sales values. As Table 6 illustrates, the sales value is highest for aluminium, followed by PET, then glass.

Table 19 Product fees per container, by material

Country	PET	Aluminium can	Glass
Norway [1]	£0.013 (0.15 NOK)	-£0.003 (-0.03 NOK)	Not available
Lithuania [2]	£0.024 (0.027 EUR)	£ 0.008 (0.009 EUR)	£0.025 (0.029 EUR)
Denmark [3]	£0.025 - £0.032 (0.028 EUR - 0.036 EUR)	£0.011 - £0.048 (0.012 EUR - 0.055 EUR)	£0.048 - £0.813 (0.055 EUR - 0.927 EUR)

[41] This adjustment was recommended by Alupro based on their expertise.

Note: Denmark's national currency is Danish Kroner, but the source published the information in Euros. Euros are converted to pounds using 2019 exchange rates retrieved from OECD https://data.oecd.org/conversion/exchange-rates.htm#indicator-chart.

Source: London Economics analysis based on [1] Speech from Infinitum https://www.reloopplatform.org/wp-content/uploads/2019/03/INFINITUM.pdf***; [2]*** https://grazintiverta.lt/en/for-business/for-manufacturers-and-importers***/ [3] CM consulting and reloop (2018). 'Deposit Systems for One-Way Beverage Containers: Global Overview.'***

As a result, product fees tend to be highest on glass and lowest on aluminium. In 2018, the product fee on an aluminium can in Norway was -£0.003. In other words, drinks producers were paid to put aluminium cans in the system. The fee on a PET bottle was £0.013. As of January 2020, in Lithuania, the product fees are £0.024 on a PET bottle, £0.008 on an aluminium can and £0.025 EUR on a glass bottle. The product fees in Denmark are found in the literature (CM consulting and reloop, 2019). The fee on a PET bottle is in the range of £0.025-£0.032; on aluminium can £0.011-£0.048; and on a glass bottles £0.048-£0.813.

To estimate product fees in the UK, one approach would be to assume that that the fees represent the cost of handling the specific material in the scheme. For example, product fees for cans would not cross-subsidise the higher cost of handling glass. However, this approach is not feasible in the model because it would require knowing the share of the DRS costs that each material is responsible for. This information is not available.

Due to this data limitation, product fees in the model are based on the lowest fees charged in Denmark. The Danish data is used as it is the most complete data set for the purpose of modelling.

The model takes the Danish product fees as a starting point and calibrates the fees for all materials incrementally until the revenue from product fees is equal to the remaining cost of the DRS. For example, the model initially lowers the product fees on cans, PET bottles, and glass bottles by £0.001 each. If the revenue is greater than the remaining cost, the model lowers the fees again. This process repeats until there is no excess or shortfall. Note that the calibration and product fees are different each year. The remaining cost to be financed by product fees is different each year. This is because although the scheme costs are constant after the first year, the volume and mix of drinks containers on the market are different each year.

5.1.3 Modelling results

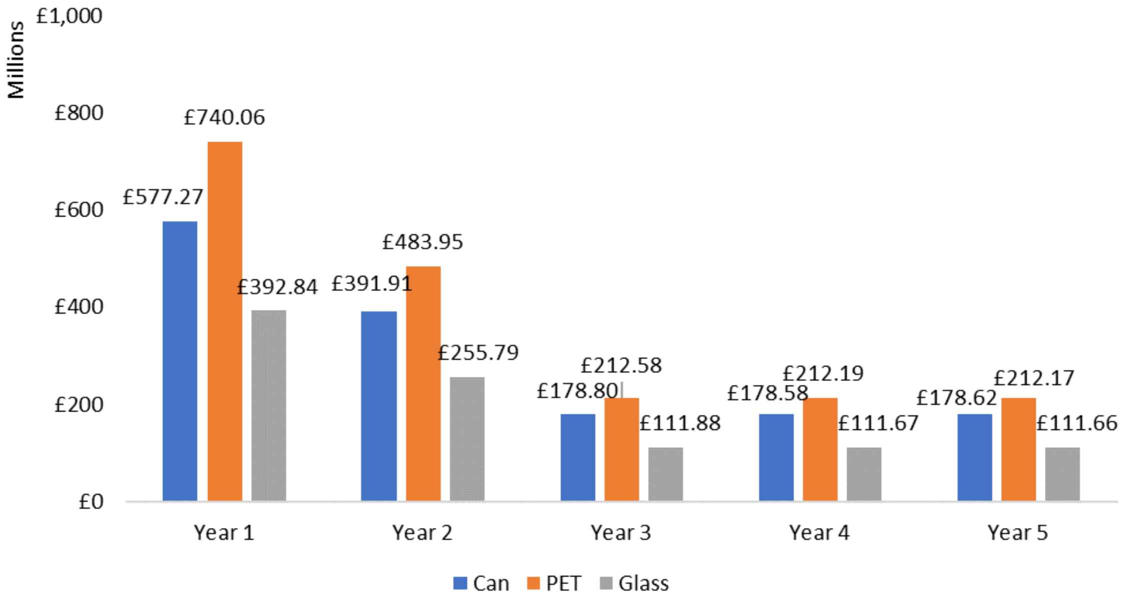
The model estimates the DRS operators' revenue from three sources: unredeemed deposits, sale of recyclates and product fees. Each revenue stream varies for a flat and variable DRS. All the estimations are conducted using the price impact assumptions for Scenario 1 (see section 3.2).

Revenue from unredeemed deposits

The revenue from unredeemed deposits covers the highest share of DRS running costs for both types of DRS. In fact, for the first two years post-DRS implementation, the total revenues generated from unredeemed deposits exceed the total costs in the same period. This is because a higher proportion of containers are estimated not to be returned due to the lower return rates in the first two years after the DRS introduction (until the return rates stabilise at 90% in the third year for both types of DRS). For both types of DRS, PET containers generate the highest revenues from unredeemed deposits, followed by cans and glass.

Even though the return rates per container are higher in the first two years for a variable rate DRS (see section 3.8), the revenues from unredeemed deposits are higher each year and across all materials for a variable rate DRS compared to a flat rate DRS (Figure 30 and Figure 31). For PET and glass, this is mostly due to the fact that the variable rate scheme charges higher deposit fees for medium and large size containers. For cans, which are mostly unaffected by the higher deposit fees under a variable rate DRS, the estimated total number of cans on the market under a variable rate DRS is higher than the equivalent number for a flat rate DRS.

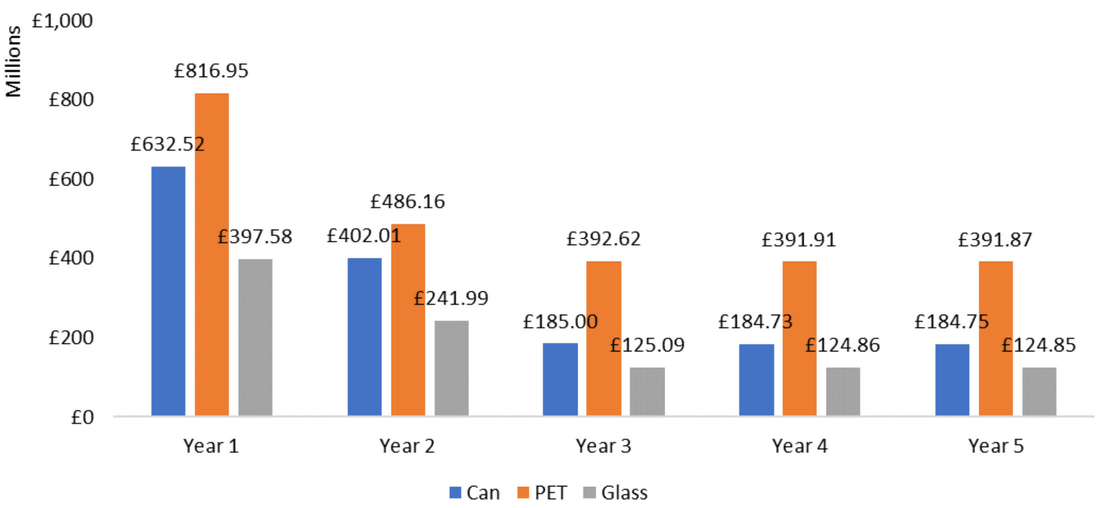
Figure 30 Revenue from unredeemed deposits under a flat rate DRS (£ millions, nominal prices)



Note: The deposit fee used per each unreturned container was 20p. Glass bottles sales estimates used in the calculation of the revenue from unredeemed deposits are equal the pre-DRS baseline estimates (see more section A5.2).

Source: London Economics analysis based on the post-DRS sales volume for cans, PET and glass under the modelling Scenario 1.

Figure 31 Revenue from unredeemed deposits under a variable rate DRS (£ millions, nominal prices)



Note: The deposit fees used were 20p for a small, 40p for a medium and 50p for a large size container. Glass bottles sales estimates used in the calculation of the revenue from unredeemed deposits are equal the pre-DRS baseline estimates (see more section A5.2).

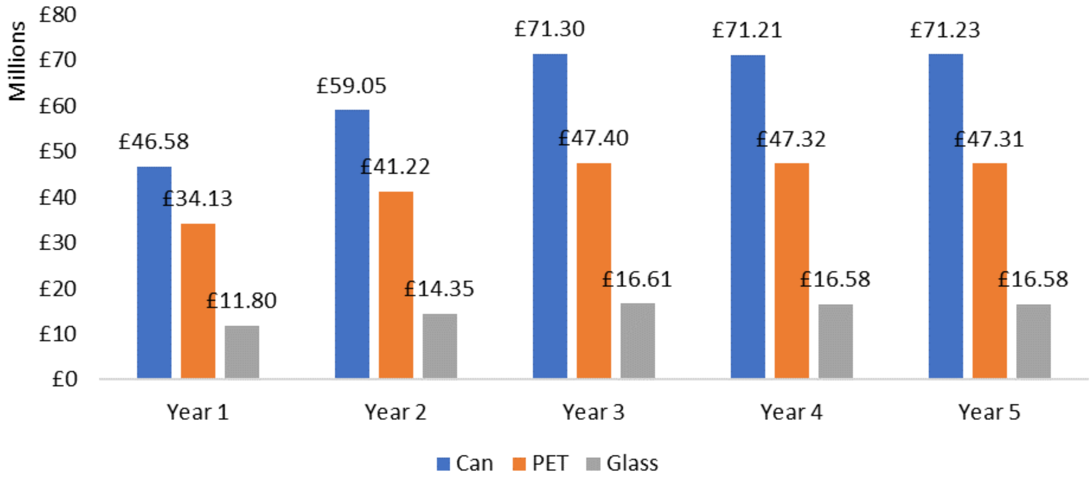
Source: London Economics analysis based on the post-DRS sales volume for cans, PET and glass under the modelling Scenario 1.

Revenue from recyclates

Selling recyclates generates lower revenues for the DRS operator than the unredeemed deposits (equating to 6% to 20% of the value of revenues from unredeemed deposits each year). Moreover, this revenue stream follows a different distribution over time and by container material. First, as the return rates increase over time to reach the 90% level in the third year, the total number of returned containers for sale grows. Second, cans contribute to the highest revenue from recyclates each year, followed by PET and glass (Figure 32 and Figure 33). This is predominantly because aluminium is worth significantly more than PET and glass (Table 18).

Overall, the total revenue from recyclates over 5 years under a variable rate DRS exceeds the revenue under a flat rate DRS by 4.4%. This difference is primarily driven by the revenue from selling cans which is higher under a variable rate DRS each year compared to a flat rate DRS. With the revenue from selling glass staying the same for both types of DRS[42], the revenue from selling PET under a flat rate DRS is predicted to slightly exceed the revenue under a variable rate DRS in the third year of the DRS running, as the difference in total number of PET sold across the DRS types decreases.

Figure 32 Revenue from recyclates under a flat rate DRS (£ millions, nominal prices)

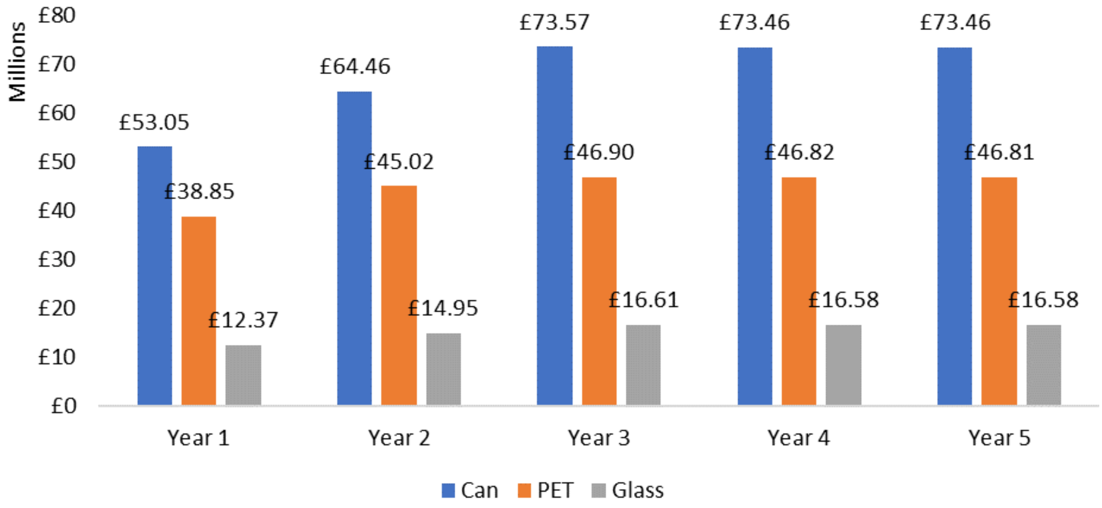


Note: Glass bottles sales estimates used in the calculation of the revenue from recyclates are equal the pre-DRS baseline estimates (see more section A5.2).

Source: London Economics analysis based on the post-DRS sales volume for cans, PET and glass under the modelling Scenario 1 and the weights of containers by material and size (Table 17) and prices of recyclates per tonne (Table 18).

[42] The model assumes no change in pre-DRS baseline demand post-DRS. See more in section A5.2.

Figure 33 Revenue from recyclates under a variable rate DRS (£ millions, nominal prices)



Note: Glass bottles sales estimates used in the calculation of the revenue from recyclates are equal the pre-DRS baseline estimates (see more section A5.2).

Source: London Economics analysis based on the post-DRS sales volume for cans, PET and glass under the modelling Scenario 1 and the weights of containers by material and size (Table 17) and prices of recyclates per tonne (Table 18).

Product fees and revenue from product fees

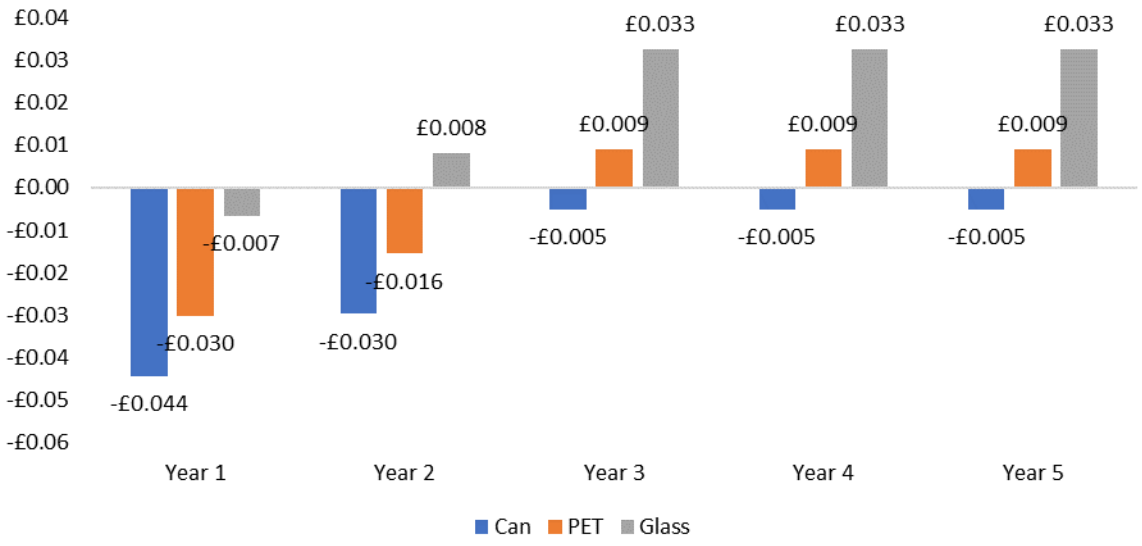
Product fees per container are established relative to the outstanding total costs per material type which cannot be covered with the revenues from unredeemed deposits and recyclates.

As shown in Figure 34 and Figure 35, the model estimates product fees to be negative across all materials and for both DRS types in the first year (i.e. the DRS operator would have to pay producers to maintain the same level of containers in circulation). Similarly, the fees are predicted to be negative for cans and PET and positive for glass in year 2. Starting from year 3, only cans will have to be subsidised, assuming that the remaining DRS costs for glass and PET cannot be cross-subsidised using the revenue surplus generated for cans.

In absolute terms, product subsidies for can producers are marginally higher under a variable rate DRS than under a flat rate scheme[43]. Product fees for glass and PET producers are higher under a flat rate DRS than under a variable rate DRS across all years (by 84% for PET and 24% for glass). This means that if the distribution of product fees in the UK mimics that found in Denmark (Table 19), the variable rate DRS is estimated to put a lower financial burden on container fillers.

[43] Only in the second year, the subsidy per container under a flat rate DRS is higher by £0.001 compared to a variable rate DRS.

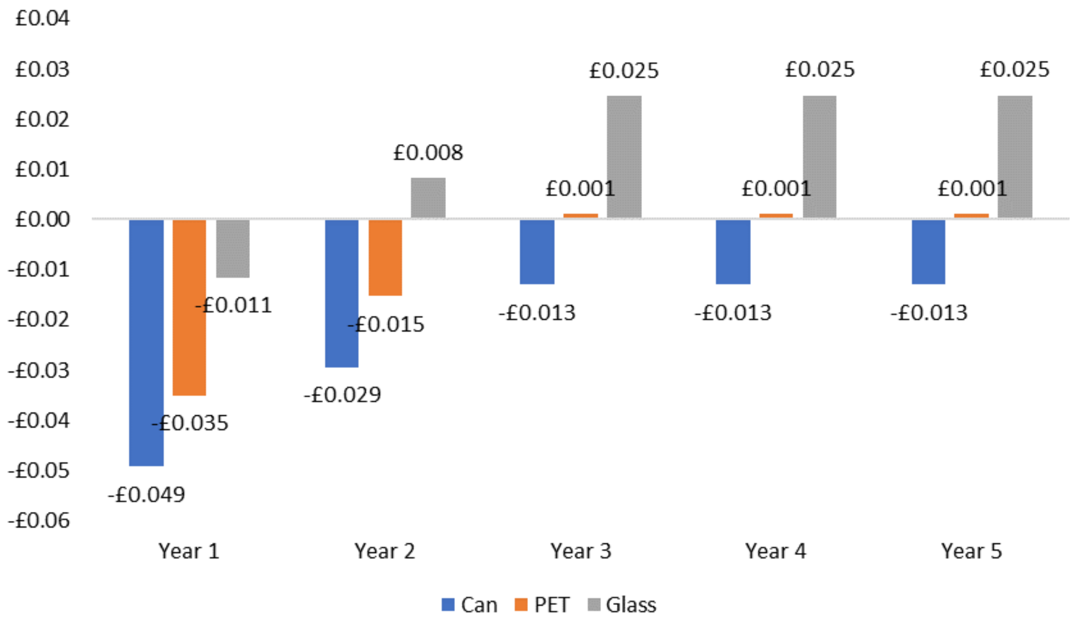
Figure 34 Product fees per container under a flat rate DRS (£, nominal prices)



Note: Glass bottles sales estimates used in the calculation of product fees are equal the pre-DRS baseline estimates (see more section A5.2).

Source: London Economics analysis based on the post-DRS sales volume for cans, PET and glass under the modelling Scenario 1, annual DRS costs (Table 16), the revenue from unredeemed deposits (Figure 30) and the revenue from recyclates (Figure 32).

Figure 35 Product fees per container under a variable rate DRS (£, nominal prices)

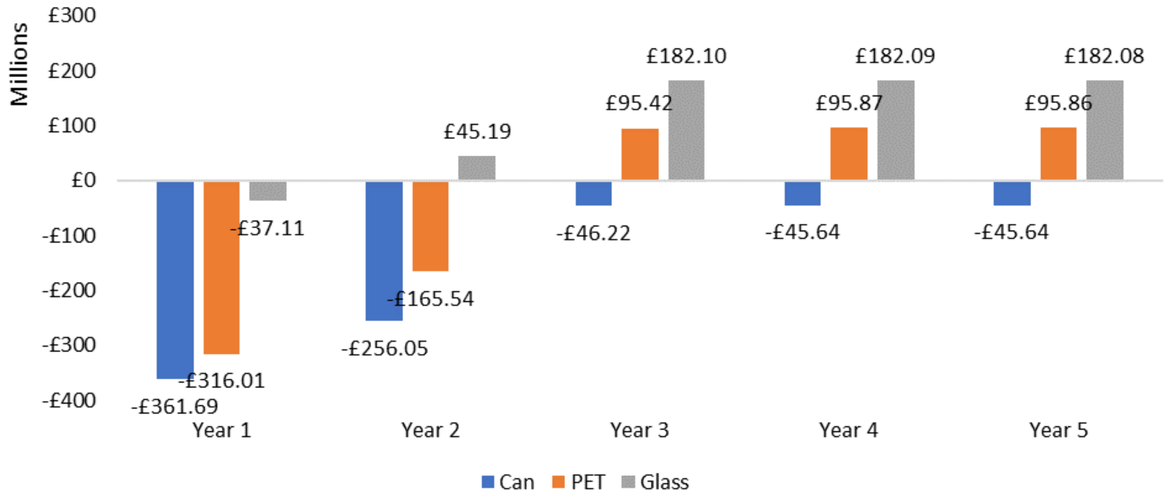


Note: Glass bottles sales estimates used in the calculation of product fees are equal the pre-DRS baseline estimates (see more section A5.2).

Source: London Economics analysis based on the post-DRS sales volume for cans, PET and glass under the modelling Scenario 1, annual DRS costs (Table 16), the revenue from unredeemed deposits (Figure 30) and the revenue from recyclates (Figure 32).

The revenues from product fees follow the same distributions per material as product fees (Figure 36 and Figure 37). The subsidies for can producers are higher under a variable rate DRS. As the revenue gap for PET and glass in years 3 to 5 is larger under a flat rate DRS, the revenues raised from producers' contributions are higher under this type of scheme.

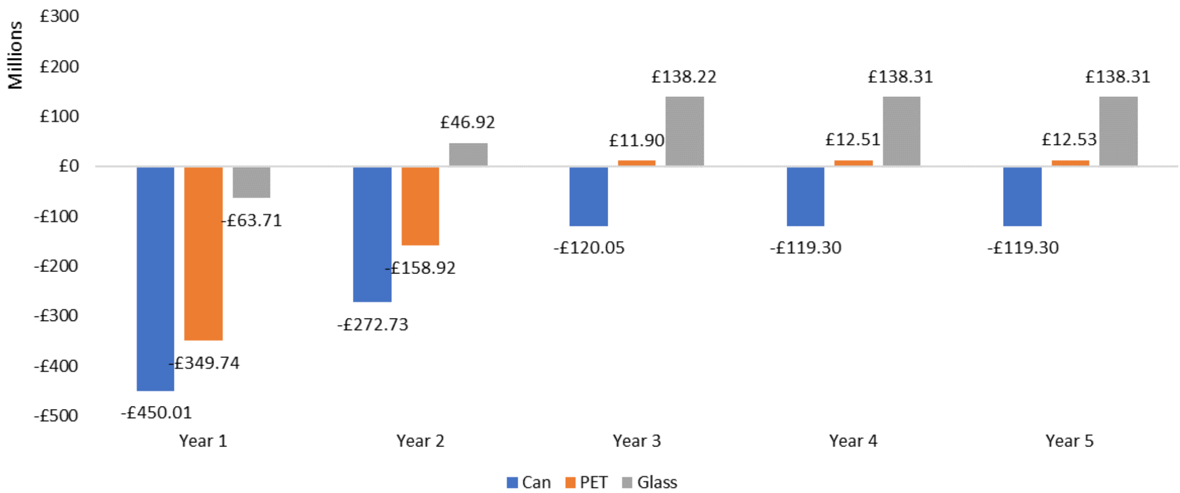
Figure 36 Revenue from product fees under a flat rate DRS (£ millions, nominal prices)



Note: Glass bottles sales estimates used in the calculation of the revenue from unredeemed deposits are equal the pre-DRS baseline estimates (see more section A5.2).

Source: London Economics analysis based on the post-DRS sales volume for cans, PET and glass under the modelling Scenario 1 and product fees by material type (Figure 34).

Figure 37 Revenue from product fees under a variable rate DRS (£ millions, nominal prices)



Note: Glass bottles sales estimates used in the calculation of the revenue from unredeemed deposits are equal the pre-DRS baseline estimates (see more section A5.2).

Source: London Economics analysis based on the post-DRS sales volume for cans, PET and glass under the modelling Scenario 1 and product fees by material type (Figure 35).

5.1.4 Key points

- The DRS operator will be not-for-profit and is likely to be financed with the revenues from unredeemed deposits, sales of collected containers (i.e. recyclates) and product fees paid by drinks producers.

- Product fees per container are established relative to the outstanding total costs per material type which cannot be covered with the revenues from unredeemed deposits and recyclates.
- The revenue from unredeemed deposits covers the highest share of DRS running costs for both types of DRS. Those revenues are higher each year and across all materials for a variable rate DRS compared to a flat rate DRS.
- Overall, the total revenue from recyclates over 5 years under a variable rate DRS exceeds the revenue under a flat rate DRS. This difference is primarily driven by the revenue from selling cans which is higher under a variable rate DRS each year compared to a flat rate DRS.
- Product fees are lower for each packaging material (cans, PET and glass) under a variable rate DRS compared to a flat rate DRS.

5.2 Environmental impact of DRS

5.2.1 Producing virgin aluminium and PET

There is considerable debate surrounding the carbon impact of aluminium can production compared to PET bottles. It has been reported that Aluminium cans are very energy-intensive to produce, accounting for 11.09 tonnes of CO2 emissions per ton of cans while plastic bottles account for only 2.2 tonnes of greenhouse gases (Reuters, 2019)[44]. However, this remains a point of debate which is outside the scope of this study.[45]

5.2.2 Recycling aluminium and PET

Recycling aluminium from new scrap only uses about 5% of the energy required to manufacture primary aluminium from raw materials, with an approximately 96% reduction in carbon emissions (Moya et al, 2015; BREF, 2014). A PET bottle made entirely from recycled materials could theoretically have a 24% smaller carbon footprint than one made from entirely virgin materials (Dormer et al. 2013).

Aluminium can be recycled indefinitely, unlike PET bottles which are generally downcycled into materials for clothing (such as t-shirts, sweaters, fleece jackets), sleeping bags, and carpeting (Recycle and recover plastics.org, 2020). Aluminium drinking cans are made from 47% recycled content on average[46], while the average PET bottle contains no more than 5-10% recycled content (WRAP, 2019). Unlike PET, aluminium retains its quality each time it is reprocessed, which means that the only limiting factor for how much recycled content an aluminium can contains is the amount of recycled aluminium in the market (Spink, 2019). Higher recycling rates of aluminium cans would result in a higher proportion of recycled content of cans, thereby lowering the carbon footprint of cans.

[44] https://www.reuters.com/article/us-environment-plastic-aluminium-factbox-idUSKBN1WW0KC

[45] https://www.letsrecycle.com/news/latest-news/can-industry-rejects-carbon-claims-by-coca-cola/

[46] In Europe, can bodies are made from 55% recycled content and can ends of 3% recycled content, which is equivalent to an average amount of recycled content per can of 47% (Aluminium Packaging Rolling Group, 2019).

5.2.3 What happens to non-recycled aluminium cans and PET bottles?

In 2019, 75% of all aluminium beverage cans sold in the UK were recycled (Alupro, 2019). The unrecycled beverage containers are thrown away and either dumped in landfills or incinerated. In recent years, the UK has been incinerating an increasing amount of waste to prevent excess pressure on landfills. Currently, just over half of general waste is incinerated (Environmental Audit Committee, 2017). Unlike PET bottles, aluminium packaging, including beverage cans, can be recovered from incinerator bottom ash (IBA) in Waste-to-Energy plants (European Aluminium Association, 2014). This recovery from IBA is one of the advantages that cans have over PET bottles, and one of the reasons why the recycling rate is much higher for aluminium. Approximately 26% of the UK's aluminium recycling comes from material recovered after incineration (Green Alliance, 2019). Between 85-90% of the aluminium from beverage cans from IBA can be recovered for recycling (Green Alliance, 2019). The climate change impact[47] of recycling an aluminium can is approximately half that of incineration (Raadal, Modahl and Iversen, 2017).

The recycling rate for PET bottles is just under 60% in the UK (Environmental Audit Committee, 2017). PET bottles that are not recycled are either incinerated (52%), littered (3%), or end up in landfills (45%) (Veolia, 2018; Environmental Audit Committee, 2017). According to the Environmental Audit Committee (2017), landfill and incineration of plastic bottles produces approximately 233,000 tonnes of CO2 equivalent emissions every year. While there is some energy recovery from waste incineration, the carbon emissions from this type of electricity production are far higher than those from coal power stations.

5.2.4 Environmental impact of littering

While carbon emissions of different materials are a useful measure of the environmental impact that beverage containers' production can have, the increased consumption of plastic contributes to several other environmental problems that cannot be easily measured. The Environmental Audit Committee (2017) estimated that 700,000 plastic bottles are littered in the UK every day. While most of these are collected by local authorities, many are swept into the rivers and oceans where they break down into microplastics. Savoca et al. (2016) experimentally demonstrate that plastic debris releases the same odour as zoo- and phytoplankton and creates a trap for marine wildlife. This is used as an explanation for why so many marine animals mistake plastic for their natural prey (Savoca et al. 2016).

Microplastics transfer toxins directly to animals that ingest the plastic, as well as consumers who eat seafood. Small particles of plastic have also been shown to cause lung and gut injures in humans, specifically when particles are fine enough to pass through cell membranes (Vethaak and Leslie, 2016). It has been estimated that the average seafood consumer in the UK ingests about 11,000 plastic particles each year (Environmental Audit Committee, 2017).

5.2.5 Environmental impact of food and drink waste

Findings from literature

Food and drink waste is a significant problem all over the world, with the average household in the UK wasting 22% of food and drink purchases, 81% of which is avoidable through meal planning and

[47] Climate change impact in this section is measured as the emission of greenhouse gasses, cumulative energy demand and fossil resource depletion.

improved storage (Wrap, 2011). Wasted food and drinks results in a financial loss of £60 per month for an average family in the UK (Wrap, 2018). However, this does not account for the environmental damage that food and drink waste contributes. By wasting food and drinks, the inputs such as the water and energy required to produce and process these products are lost (Tonini, Albizzati and Astrup, 2018). In addition, the greenhouse gasses emitted, and land-use change that occurred to produce these food and drinks could have been avoided.

Carbonated soft drinks are in the list of the top 10 most wasted food and drink items, and roughly 15% of all drinks purchased are wasted in the UK (Wrap, 2018). Based on 2009 estimates, carbonated soft drinks account for approximately 280,000 tonnes of food waste per year, all of which could be avoided (Wrap, 2009).

Although there is limited information in the literature on the relationship between food waste and the size of packaging, Wilson et al. (2015) find that consumers' Willingness To Waste (WTW)[48] is higher for large products relative to small products. In addition, Wohner et al. (2018) found that one third of all households surveyed claimed that they would waste less food and drinks if the sizes of products were more suited to their needs. Consumer diaries used for a Wrap report (2009) reveal that drinks waste is predominantly caused by serving sizes being too large.

The environmental impact of food and drink waste is generally evaluated by calculating the water footprint, carbon footprint and the amount of land-use change associated with the resources needed to produce and process the products being wasted (Tonini, Albizzati and Astrup, 2018). However, the bulk of the literature on the environmental impact of food and drink waste has focused on evaluating food waste. Wrap (2012) estimate that approximately 3.3 tonnes of CO_2 equivalent are released for every tonne of drink waste.

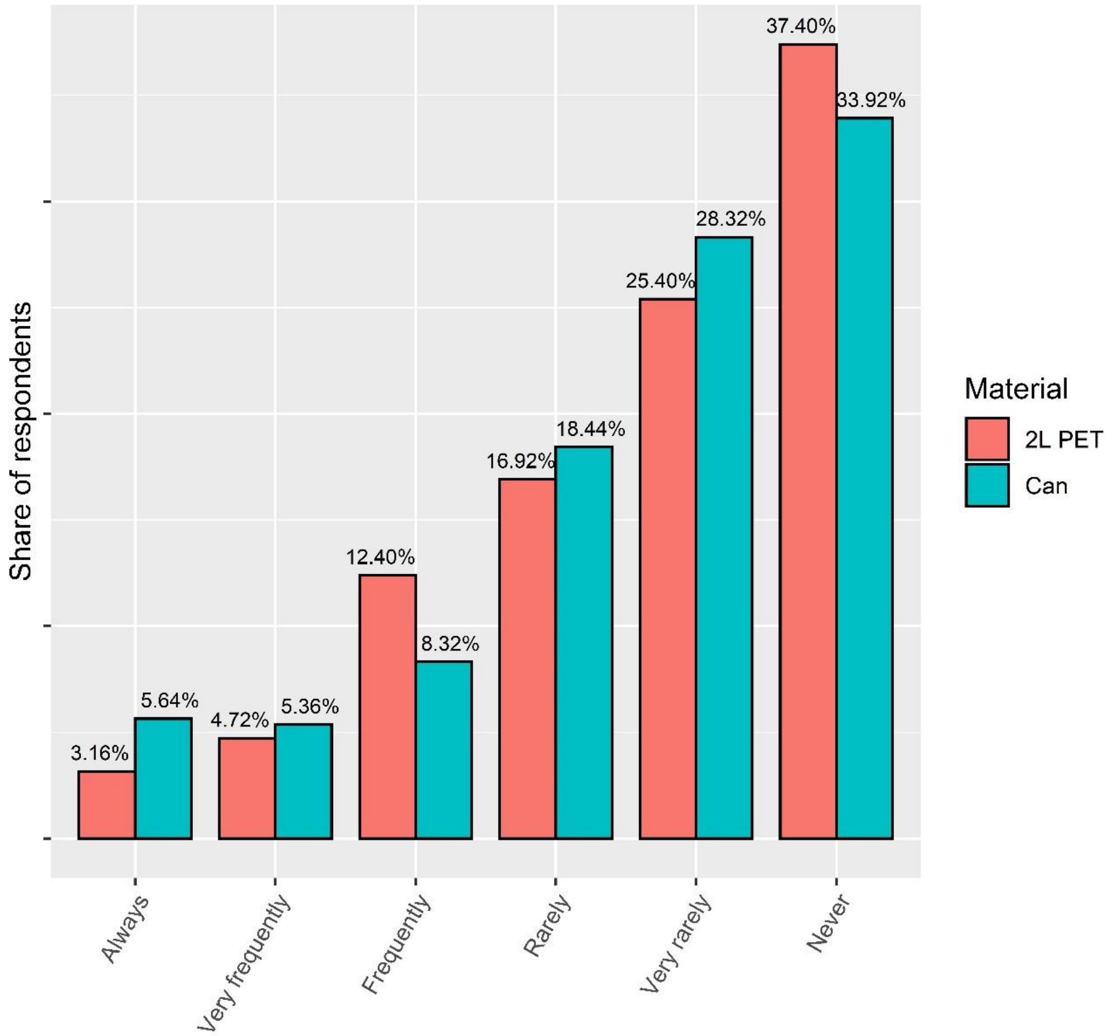
Findings from consumer survey

In the consumer survey, some questions were asked to see if cans or PET bottles make respondents more likely to waste drink.

Respondents were asked how often they waste a proportion of their drink from 2 litre PET bottles and 330ml cans after consuming the desired amount. As can be seen from Figure 38, there is no great difference in how often consumers report to waste drink from either type of beverage container. For example, 34% of consumers never throw out any drink from cans, and 37% report the same for 2 litre bottles.

[48] Willingness to waste (WTW) = Willingness to pay (WTP) – expected consumption

Figure 38 How often do you throw away some of the contents in a [can/2 litre bottle] after consuming the desired amount?



Source: London Economics

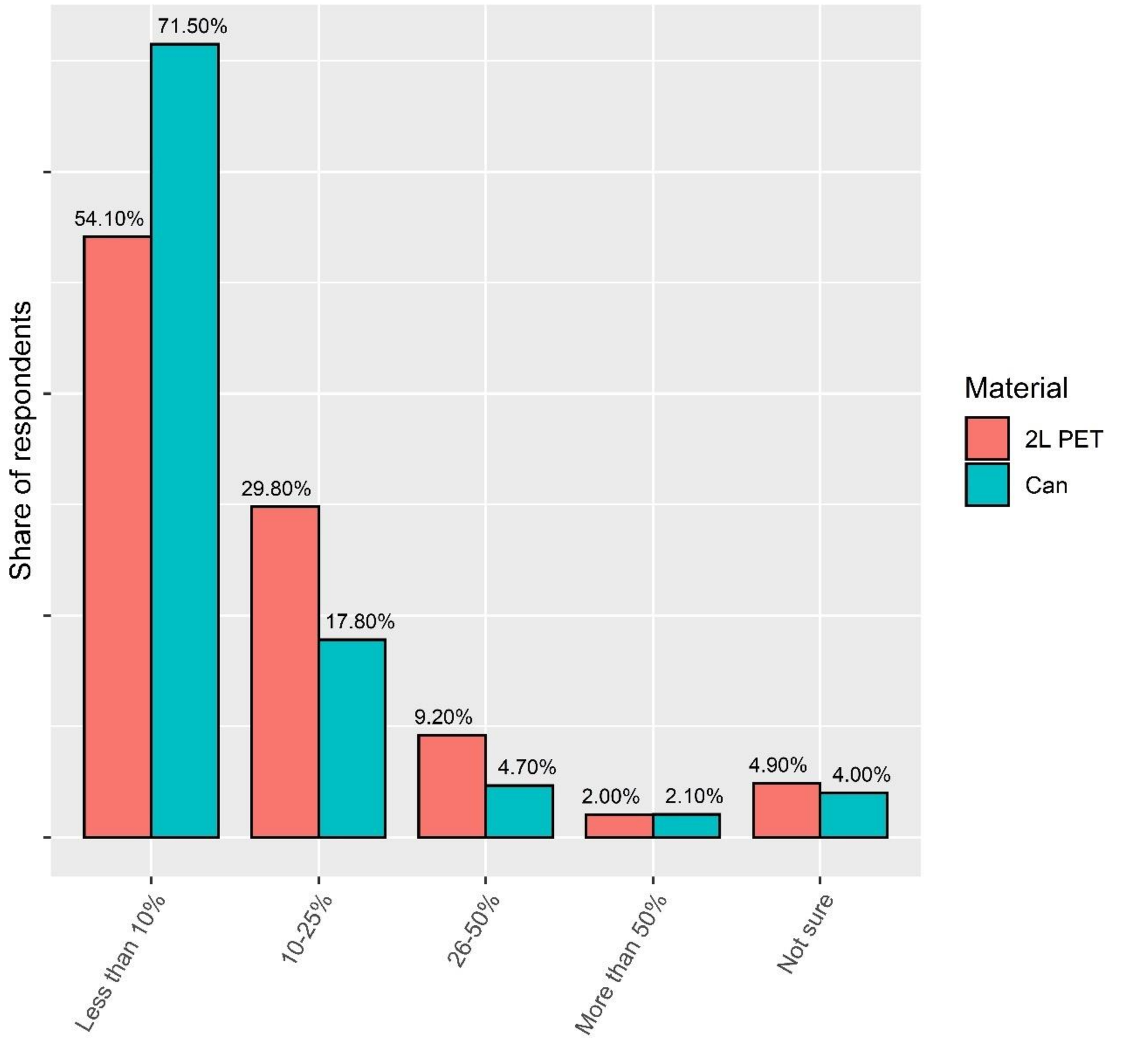
The survey then asked those who reported that they throw out some of the beverage what proportion they generally waste.

Respondents tend to report to waste a smaller portion of the drink from cans than from 2 litre bottles (Figure 39). Among those who throw away drink from cans, 71% throw away less than 10% of the drinks. Among those who throw away drink from bottles, 54% throw away less than 10% of the drinks.

Furthermore, more respondents report to waste higher portions of the drink from bottles than cans (Figure 39). Among those who throw away drink from cans, 18% throw away 10-25% of the drink and 5% throw away 26-50% of the drink. Among those who throw away drink from bottles, 30% throw away 10-25% of the drink and 9% throw away 26-50% of the drink.

- Consumer survey results – for larger PET bottles nearly 40% of respondents waste at least 10% of the contents, with 10% throwing away at least 25% of the product, compared to cans where not even 20% of people wasted more than 10% of the products.

Figure 39 In the event that you throw out some of the beverage [in a 2 litre bottle or can], what proportion of the beverage do you generally throw out?



Source: London Economics

Overall, the results from the survey indicate that consumers are almost equally likely to throw out drinks in cans and 2L PET bottles. However, consumers tend to throw out a larger proportion of drink in 2 litre bottles than in cans. This indicates that when consumers buy the same amount of drinks in large PET bottles and cans, they are more likely to waste more drinks from PET than cans.

5.2.6 Key points

- In terms of the amount of carbon emitted during the manufacturing of beverage containers, PET bottles emissions are lower than aluminium.
- Cans that are made from recycled aluminium have a lower carbon footprint than PET bottles (recycled and virgin).
- The average aluminium can in the UK is made from roughly 47% recycled material.
- Aluminium has a recycling advantage over PET as it can be recycled indefinitely without the quality of the material degrading, making it an appropriate material for a circular economy.

- PET bottles that are recycled are unlikely to end up as new plastic bottles, but rather as clothing/carpets which eventually end up in landfills or being incinerated.
- There is some evidence that food and drink waste is greater when food and drink are provided in larger containers.

5.3 Public health impact of a flat rate DRS

A flat rate DRS in which a deposit of, for example, 20p is paid on every beverage regardless of size increases the per litre price of drinks in smaller containers relative to the per litre price of drinks in larger containers. In particular, the relative increase in price is greater for drinks sold in multipacks which might lead to consumers switching to larger, cheaper containers to purchase the same amount of beverage. As a result, the size of a single portion of beverage could change. For example, consumers incentivised to purchase their beverages in 2L bottles instead of 6-packs of 330ml cans may have less control over the portion of beverage they drink 'in one go'. The underlying theory explaining the relationship between the container size and consumption levels is referred to in the literature as the 'portion size effect'.

The portion size effect describes the phenomenon whereby consumers increase their consumption of food and beverages when offered larger portions or packages. Chandon and Wansink (2012) suggest that the reason for this is that individuals take packaging size as a cue for an appropriate serving size.

The evidence in the literature shows that the portion size effect is robust and enduring (Hetherington and Blundell-Birtill, 2018). In a meta-analysis of the portion size effect in food and beverages, Zlatevska, Dubelaar and Holden (2014) found that doubling portion size increased consumption by 35% on average. The effect, however, is non-linear; as portions become increasingly larger, the effect diminishes. The World Health Organization (WHO) (2015) similarly found that exposure to larger portions and/or bigger packages significantly increases the consumption of food and beverages. Increases in portion sizes for food and beverages result in a 12% to 16% increase in daily calorie intake if sustained for each meal (Hollands et al, 2015).

Flood, Roe and Rolls (2006) find that, among participants in a field experiment, women and men drank 10% and 26% more respectively, when the size of their beverage was increased by 50% during a meal. Furthermore, individuals did not vary the amount of food eaten during the meal when served high-caloric versus low-caloric beverages. As a result, total energy intake was increased significantly on days when participants drank high-caloric beverages.

Although the portion size effect has predominantly been explored in food and non-alcoholic drink portions, there is some evidence that it holds for alcoholic drinks as well. Kersbergen et al. (2018) conducted experiments in both a laboratory and in the field in which subjects were served alcoholic beverages in different sized glasses. They found that a 25% reduction in the size of the glass resulted in a 20-23% reduction in the amount of alcohol consumed in one hour in a laboratory experiment, while it led to a 32-40% reduction in alcohol consumed over three hours in a bar setting.

In addition to the portion size effect, a relative decrease in the price of larger beverage containers could also lead to stockpiling of beverages. Chandon and Wansink (2002) conducted a large-scale field experiment and found that the average daily intake of juice increased by 110% in the days after households bought a large promotional pack as opposed to their usual purchase volume.

5.3.1 Quantifying the health implications

While the literature has focused on the portion size effect, there is little published literature on the link between portion size and public health effects.

Supersizing, however, which is the act of selling sweets, snacks and drinks in larger sizes has often been cited as one of the leading reasons for why obesity rates in the USA have increased at a faster rate than for the rest of the developed world (Chandon and Wansink, 2012). Chandon and Wansink (2012), found that supersizing resulted in a 30% increase in calorie intake for adults.

Nearly two-thirds of adults (16 years and older), and almost a third of children are overweight or obese in the UK (Ng, et al. 2012). Obesity significantly increases the risk for many serious health problems including cardiovascular disease, type 2 diabetes, and certain cancers (British Heart Foundation, 2015; Mardis, 2001). According to Ng et al. (2012), nearly 20% of daily calories consumed by adults in the UK come from beverages.

Furthermore, Kersbergen et al. (2018) estimated that a 25% reduction in serving size of on-trade alcoholic beverages could reduce the number of alcohol-related hospital admissions in the United Kingdom by 4.4–10.5% and deaths by 5.6–13.2%, each year.

As presented in Table 23 and Table 24, the demand for large single PET and small multipacks of large PET is estimated to increase post-DRS (for both DRS types) relative to the no-DRS baseline (Table 24). Nevertheless, the demand for larger PET containers increases by less under a variable rate DRS compared to a flat rate DRS. Combining these estimates with the evidence from the literature could suggest that a flat rate DRS could contribute more to higher rates of obesity and associated health problems than a variable rate DRS. However, further research is required to investigate this further before any firm conclusions can be made.

5.3.2 Key points

- Increased portion sizes are causally linked to an increase in daily calorie intake for adults and children
- A large portion of daily calories consumed by individuals in the UK come from beverages
- An increase in the portion size of beverages could have implications for the health of both adults and children in the UK

6 Arguments against and in favour of a variable rate DRS

This section aims to highlight some of the key arguments which have been made against and in favour of the introduction of a variable rate scheme in the UK. The following points are the most prevalent arguments that have been found in the literature either against a variable deposit (or in favour of a flat rate deposit) or in favour of a variable DRS. In addition, this study's results are used to supplement some of the literature findings.

- Consumers do not want a variable rate

Public consultations regarding DRS that took place in Scotland in 2018 reveal that although more than half the respondents were in favour of a deposit of £0.15 or more, only a third of those respondents were in support of a variable rate deposit (Scottish Government, 2020).

However polls conducted by Norstat, on behalf of the campaign group Nature 2030 in the countries with existing variable rate DRS, such as Sweden, Denmark Finland and Norway, found that more than 70% of respondents agreed that a variable deposit was fairer than a flat one[49].

- Flat rate schemes are easier to understand

A deposit of £0.20 on all beverage containers is easier to understand and to remember than if each container size had a different deposit (Scottish Government, 2019).

However, according to a survey conducted by environmental campaign group A Plastic Planet, only 13% of UK consumers would not be able to understand the fees system under a variable rate DRS[50]. Furthermore, the polls by Norstat find that at least 97% of consumers from the countries with a variable rate DRS in place[51], find their respective schemes 'easy to use and understand'[52].

- Variable rates dis-incentivize returns for small containers

The Scottish Government (2019) raised concerns that variable rate schemes may lower the public's perception of the value of smaller containers which could lead to lower return rates for these containers. This argument is echoed by Wildlife and Countryside Link (2019), who add that because one of the objectives of the DRS is to reduce all litter, all containers should require the same incentives not to litter.

As described in section 2.4 of this report, higher deposit fees tend to achieve higher return rates. The econometric model suggests that in order to achieve a return rate of 90% or above, deposit fees should lie within the range between approx. £0.14 - £0.31 (regardless of the type of scheme).

[49] https://news.stv.tv/politics/variable-deposit-return-scheme-urged-by-campaigners?top

[50] https://www.thenational.scot/news/17780560.scots-would-grasp-variable-rate-deposit-return-scheme/

[51] Sweden, Denmark, Finland and Norway

[52] https://news.stv.tv/politics/variable-deposit-return-scheme-urged-by-campaigners?top

Therefore, as long as the lowest deposit value in a variable fee system is set within this range, then small containers are likely to be carrying a sufficient incentive to encourage their return.

- Flat rate DRS achieves the objectives at a lower cost

Both variable and flat-rate schemes have been found to increase the return rates for containers. Comparing recycling rates in different countries under different schemes, as was done in the literature review section of this report (Section 2), shows that there is no clear correlation between the type of scheme implemented and the over-all recycling rate. Both schemes can therefore achieve the main objective of a DRS, however there have been some arguments that a variable rate may involve a higher outlay for consumers, and more complexity for producers which could result in higher administrative costs (Scottish Government, 2020).

Contrary to this, the consumer survey conducted as part of this study found that a variable rate DRS achieves higher return rates in the first two years of the scheme running (approx. 75% in the first year and 89.6% in the second year compared to 65% and 77.3% under a flat rate DRS, respectively) at a lower cost to beverage producers. The estimated product fees are lower for all types of packaging material (cans, PET, glass) under a variable rate DRS (section 5.1.3) compared to a flat rate DRS.

- Variable scheme is more expensive to consumers

A variable deposit based on the size of a container may increase the cost to consumers. Modelling work done by the Scottish Government (2020) estimates that low income households will have an additional outlay of £1.40 which will be spent on beverage container deposits. Although this amount can be recovered when containers are returned, it is likely to be spent on further beverage deposits instead of being repurposed for other necessities. The Scottish Government raised concerns that a variable rate deposit may increase the total outlay for households.

As described in section 3.2, under modelling scenario 1, in relative terms, more consumers will return their containers under a variable rate DRS in the first two years after the implementation and incur the additional lower cost of effort at 1p per container instead of the full deposit fee value.

7 Conclusions

The objective of this study was to assess the economic impact on the aluminium can production industry of a DRS. The study examines the impact on total volume of PET and cans on the market and can producers' revenue under a fixed and variable rate DRS; and, compares these outcomes to a no-DRS baseline.

Alupro commissioned the work as they are concerned that a flat fee DRS will lead to consumers switching from smaller portion containers, like cans, towards larger PET bottles.

Overall, the modelling finds that the introduction of a DRS will reduce the total volume of drinks packaging on the market (PET and cans). It is estimated that under a flat rate DRS the total volume of PET bottles on the market will decrease by 407 million units (0.76%) while the total volume of cans will decrease by 3,244 million units (6.93%).[53] In comparison, under a variable rate DRS the total volume of PET bottles will decrease 1,503 million units (2.82%) and the volume of cans will decrease by 736 million units (1.57%).

The extent to which volumes decrease depends on consumer demand behaviour:

1. How consumers perceive the deposit fee at point of purchase and whether they view the deposit fee as a refundable deposit, or they see it as tax at point of purchase.
2. How sensitive demand for drinks in different packaging is to a change in the price of their packaging substitute e.g. how sensitive demand for cans is in response to a change in the price of the same drink in plastic packaging and vice versa.

Both scheme designs are expected to achieve the same return rates from year 3 onwards at 90%. This is supported by literature on existing schemes internationally and responses to the consumer survey conducted as part of this study. In the first 2 years, findings from the consumer survey suggest that return rates will be higher under a variable rate DRS. If we assume that newer schemes have lower rates of return in their early years as customers become used to returning their containers, the return rates for flat and variable rate schemes are very similar.

The economic impact on can producers' revenues are lower under a variable rate scheme. In the first two years of scheme operation sales and revenues are 12.3% higher (year 1) and 7.6% (year 2) than under a flat rate scheme. These first years of scheme operation may be particularly important as can producers respond to the decrease in consumer demand. Over the 5 year period revenues are 6% higher under a variable DRS compared to a flat rate DRS.

The study also assessed the impact of the DRS design on scheme funding. Overall, a variable rate DRS results in lower product fees for all container manufacturers (PET, cans and glass). Across the 5 year modelling period product fees are 84% lower for PET and 24% for glass. Product fees are negative for can producers under both designs. Under the variable DRS scheme operator revenue from unredeemed deposits and recyclates mean that product fees for all materials can be set lower than under a flat rate scheme in order for the scheme to break even.

The impact on can production GVA is also found to be lower under a variable DRS as compared to a fixed rate scheme. On average under a variable rate DRS, GVA decreases in a range between £2.27

[53] For scenario 1 in the modelling (section 3**Error! Reference source not found.**).

and £7.12 million. The decrease is larger for a fixed rate DRS, with the decrease in GVA ranging between £142.4 million and £7.12 million.

The modelling also finds that under a flat rate DRS the volume of larger PET bottles on the market is greater than under a variable rate scheme. While the evidence on drink portion control and health impacts is limited, there is some evidence which suggests that larger volume containers can lead to increased consumption leading to negative health impacts for consumers.

When considering the design of a DRS it is important to take into account consumer demand response towards different packaging types for the same drink. This study has found that consumer demand response is very sensitive to changes in the price of a substitute product in a different packaging type (e.g. cola in 2 litre plastic bottles and a small pack of 6 cans). If this sensitivity holds true, then a variable rate DRS results in a lower negative impact on aluminium can producers as compared to a flat rate scheme.

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References

Aluminium Packaging Rolling Group (2019). Defining an average recycled content for aluminium cans in Europe.

Alupro. (2019). Aluminium drink cans hit 70% Recycling rate, and increase of 38% in just eight years. https://alupro.org.uk/aluminium-drink-cans-hit-75-recycling-rate-an-increase-of-38-in-just-eight-years/#:~:text=The%20UK%20aluminium%20drink%20can,being%20sent%20around%20the%20globe

Ashdale Consulting. (2019). Westons Cider Report 2019.

Balcers et.al. (2019) 'Deposit Return Systems for Beverage Containers in the Baltic States. Riga: Green Liberty'. Retrieved 27 August 2020 from https://www.researchgate.net/publication/332242306_Deposit_Return_Systems_for_Beverage_Containers_in_the_Baltic_States_Rga_Green_Liberty

Boustead, I. (2005). Eco-profiles of the European plastics industry: Polyethylene Terephthalate (PET) (Bottle grade). Report for PlasticsEurope.

British Heart Foundation. (2015). Policy statement: Sugary sweetened beverages tax.

British Soft Drinks Association. (2019). BSDA Annual Report 2019 UK Soft Drinks Report, p. 10.

Can Makers. (2016). The Can Makers Report 2016.

Chandon, P., & Wansink, B. (2012). Does food marketing need to make us fat? A review and solutions. Nutrition reviews, 70(10), 571-593.

Chandon, P., & Wansink, B. (2002). When are stockpiled products consumed faster? A convenience–salience framework of post purchase consumption incidence and quantity. Journal of Marketing research, 39(3), 321-335.

Cusano, G., Gonzalo, M. R., Farrell, F., Remus, R. Roudier, S. and Delgado Sancho, L. (2017). Best Available Techniques (BAT) Reference Document for the Non-Ferrous Metals Industries. European Commission. *JRC Science for Policy Report.* https://eippcb.jrc.ec.europa.eu/sites/default/files/2020-01/JRC107041_NFM_bref2017.pdf

Defra (2019). Introducing a Deposit Return Scheme on beverage containers. Retrieved 8 December 2020 from https://consult.defra.gov.uk/environment/introducing-a-deposit-return-scheme/supporting_documents/depositreturnconsultia.pdf

DellaVigna, S., (2009). Psychology and economics: Evidence from the field. Journal of Economic literature, 47(2), pp.315-72.

Dormer, A., Finn, D. P., Ward, P., et al. (2013). Carbon footprint analysis in plastics manufacturing. *Journal of Cleaner Production*. In press. DOI: 10.1016/j.jclepro.2013.01. 014

Department for Environment, Food and Rural Affairs. (2019). Consultation on introducing a Deposit Return Scheme in England, Wales and Northern Ireland.

Environmental Audit Committee. (2017). Plastic bottles: Turning Back the Plastic Tide. House of Commons.

European Aluminium Association. (2014). More aluminium packaging recovered from incinerator bottom ashes than expected. Available at https://www.european-aluminium.eu/media/1337/fact_-sheet-alu_recovery_bottom_ashes_feb14final-1.pdf

Hetherington, M. M., & Blundell-Birtill, P. (2018). The portion size effect and overconsumption–towards downsizing solutions for children and adolescents. *Nutrition Bulletin*, 43(1), 61-68.

Hollands, G. J., Shemilt, I., Marteau, T. M., Jebb, S. A., Lewis, H. B., Wei, Y., ... & Ogilvie, D. (2015). Portion, package or tableware size for changing selection and consumption of food, alcohol and tobacco. Cochrane database of systematic reviews, (9).

HM Treasury. (2020). The Green Book. Central Government guidance on appraisal and evaluation. Retrieved 1 December 2020 from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/938046/The_Green_Book_2020.pdf

Independent Competition and regulatory Commission. (2019). Container Deposit Scheme Price Monitoring' Retrieved 27 August 2020 from https://www.icrc.act.gov.au/__data/assets/pdf_file/0020/1407602/Container-Deposit-Scheme-Price-Monitoring-Final-Report.pdf

International Monetary Fund (IMF). (2020). CPI inflation forecast UK 2020-2024.

Kersbergen, I., Oldham, M., Jones, A., Field, M., Angus, C., & Robinson, E. (2018). Reducing the standard serving size of alcoholic beverages prompts reductions in alcohol consumption. *Addiction*, 113(9), 1598-1608.

Lee et.al (2019). 'Recycling DRS in Scotland'. Retrieved 1 September 2020 from https://www.britglass.org.uk/sites/default/files/Recycling%20DRS%20in%20Scotland_OHL%20report_Final.pdf

Mantzari, E., Hollands, G. J., Pechey, R., Jebb, S., & Marteau, T. M. (2018). Perceived impact of smaller compared with larger-sized bottles of sugar-sweetened beverages on consumption: a qualitative analysis. *Appetite*, 120, 171-180.

Mardis, A. L. (2001). Current knowledge of the health effects of sugar intake. *Family Economics and Nutrition Review*, 13(1), 87-87.

Markus. (2009). A review of the German mandatory deposit for oneway drinks packaging and drinks packaging taxes in Europe. Retrieved 25 August 2020 from https://core.ac.uk/download/pdf/6781128.pdf

Moya, J. A. and Boulamanti, A. (2015). Energy efficiency and GHG emissions: Prospective scenarios for the Aluminium Industry. Report 9789279657344, EU Science Hub.

Nielsen. (2020). Global Snapshot: Great Britain Beer sales data.

Nielsen. (2020). Global Snapshot: Great Britain Cider sales data.

Nielsen. (2020). Global Snapshot: Great Britain Flavoured carbonates sales data.

Ng, S. W., Ni Mhurchu, C., Jebb, S. A. and Popkin, B. M., (2012). Patterns and trends of beverage consumption among children and adults in Great Britain, 1986-2009. *British Journal of Nutrition*. 108(3), 536-51

Oxford Economics (2016). The Economic Impact of the Soft Drinks Levy. Retrieved 9 October 2020 from https://www.britishsoftdrinks.com/write/MediaUploads/Publications/The_Economic_Impact_of_the_Soft_Drinks_Levy.pdf

Office for National Statistics (2014). 2014 UK input-output analytical tables. Retrieved 25 August 2020 from https://www.ons.gov.uk/economy/nationalaccounts/supplyandusetables/datasets/ukinputoutputanalyticaltablesdetailed

Office for National Statistics (2014). 2014 edition of Industry (2, 3 and 5 - digit SIC) - Business Register and Employment Survey (BRES): Table 2. Retrieved 25 August 2020 from https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/industry235digitsicbusinessregisterandemploymentsurveybrestable2

Office for National Statistics (2018). A guide to interpreting monthly gross domestic product. Retrieved 8 December 2020 from https://www.ons.gov.uk/economy/grossdomesticproductgdp/methodologies/aguidetointerpretingmonthlygrossdomesticproduct#gva-or-gdp

Quirmbach D, Cornelsen L, Jebb SA, et al. J (2018). Effect of increasing the price of sugar-sweetened beverages on alcoholic beverage purchases: an economic analysis of sales data Epidemiol Community Health 2018; 72:324–330.

Savoca, M. S., Wohlfeil, M. E., Ebeler, S. E. and Nevitt, G. A. (2016). Marine plastic debris emits a keystone infochemical for olfactory foraging seabirds. Science advances, 2(11), e1600395.

Scottish Government. (2020). Managing waste: Deposit return scheme. Retrieved 4 December 2020 from https://www.gov.scot/policies/managing-waste/deposit-return-scheme/

Scottish Government. (2019). A Deposit Return Scheme for Scotland - Full Business Regulatory Impact Assessment' Retrived 25 August 2020 from https://www.gov.scot/publications/deposit-return-scheme-scotland-full-business-regulatory-impact-assessment/

Sousa, J. (2014). Estimation of price elasticities of demand for alcohol in the United Kingdom. London: Her Majesty's Revenue and Customs. Retrieved 9 October 2020 from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/387513/HMRC_WorkingPaper_16_Alcohol_elasticities_final.pdf

Spink, A. (2019). Don't bottle it: why aluminium cans may be the answer to the world's plastic problem. Geographical Magazine. https://geographical.co.uk/people/development/item/3560-aluminium-cans

Statista (2020). Consumer Market Outlook 2020 - Beer, United Kingdom

Statista (2020). Consumer Market Outlook 2020 - Carbonated Soft Drinks, United Kingdom

Statista (2020). Consumer Market Outlook 2020 - Cider, Perry & Rice Wine, United Kingdom

STV News (2020). 'Nordic-style bottle return scheme urged for Scotland'. Retrieved 17 December 2020 from https://news.stv.tv/politics/variable-deposit-return-scheme-urged-by-campaigners?top

The National (2019). 'Scots 'would grasp' variable rate deposit return scheme. Retrieved 17 December 2020 from https://www.thenational.scot/news/17780560.scots-would-grasp-variable-rate-deposit-return-scheme/

Tonini, D., Albizzati, P. F., & Astrup, T. F. (2018). Environmental impacts of food waste: Learnings and challenges from a case study on UK. *Waste Management*, *76*, 744-766.

UK Department for Environment, Farming and Rural Affairs (DEFRA) (2019). 'Introducing a Deposit Return Scheme on beverage containers'. Retrieved 5 October 2020 from https://consult.Defra.gov.uk/environment/introducing-a-deposit-return-scheme/supporting_documents/depositreturnconsultia.pdf

Veolia. (2018). Plastic Recycling Report 2018. Developed in conjunction with Recoup. https://www.veolia.co.uk/sites/g/files/dvc1681/files/document/2018/09/Veolia%20UK%20_%20Plan%20for%20Plastics%20%7C%20The%20Circular%20Solution.pdf

Vethaak, A. D. and Leslie, H. A. (2016). Plastic debris is a human health issue. Environ. Sci. Technol. 2016, 50, 6825−6826

Wildlife and Countryside Link, and Northern Ireland Environment Link. (2019). Introducing a Deposit Return Scheme in England, Wales and Northern Ireland.

Wilson, N. L., Rickard, B. J., Saputo, R., & Ho, S. T. (2017). Food waste: The role of date labels, package size, and product category. *Food Quality and Preference*, *55*, 35-44.

Wohner, B., Pauer, E., Heinrich, V., & Tacker, M. (2019). Packaging-related food losses and waste: an overview of drivers and issues. *Sustainability*, *11*(1), 264.

World Health Organisation (2015). Portion, package or tableware size for changing selection and consumption of food, alcohol and tobacco. Available at https://www.who.int/elena/titles/review_summaries/portion-size/en/

Wrap (2009). Household Food and Drink Waste in the UK. Available at https://www.wrap.org.uk/sites/files/wrap/Household_food_and_drink_waste_in_the_UK_-_report.pdf

Wrap (2011). Water and Carbon footprint of food and drink waste in the UK. Available at https://waterfootprint.org/media/downloads/Water-and-carbon-footprint-food-and-drink-waste-UK-2011_1.pdf

Wrap (2012). Methods used for Household Food and Drink Waste in the UK. Available at https://www.wrap.org.uk/sites/files/wrap/Methods%20Annex%20Report%20v2.pdf

Wrap (2018). Food surplus and waste arisings in the UK. Available at https://www.wrap.org.uk/sites/files/wrap/Estimates_%20in_the_UK_Jan17.pdf

WRAP. (2019). Plastics: Market Situation Report 2019.

Zlatevska, N., Dubelaar, C., & Holden, S. S. (2014). Sizing up the effect of portion size on consumption: a meta-analytic review. Journal of Marketing, 78(3), 140-154.

Annex 1 International DRS return rates, by material and type of scheme

Country	Material	Year recorded	Return rate	Type of scheme
Denmark	Can	2019	90%	Variable
Estonia	Can	2017	73%	Flat
Finland	Can	2016	96%	Variable
Germany	Can	2015	99%	Flat
Iceland	Can	2014	90%	Flat
Lithuania	Can	2017	93%	Flat
Norway	Can	2018	87%	Variable
Sweden	Can	2019	86%	Variable
Denmark	Glass	2016	90%	Variable
Estonia	Glass	2017	88%	Flat
Finland	Glass	2016	88%	Variable
Iceland	Glass	2014	83%	Flat
Lithuania	Glass	2017	83%	Flat
Australian Capital Territory, Australia	Overall	2019	53%	Flat
Croatia	Overall	2016	87%	Flat
Denmark	Overall	2019	92%	Variable
Estonia	Overall	2017	83%	Flat
Finland	Overall	2016	92%	Variable
Germany	Overall	2015	98%	Flat
Iceland	Overall	2014	90%	Flat
Lithuania	Overall	2017	92%	Flat
New South Wales, Australia	Overall	2019	60%	Flat
Northern Territory, Australia	Overall	2017	75%	Flat
Norway	Overall	2016	92%	Variable
Queensland, Australia	Overall	2019	30%	Flat
South Australia, Australia	Overall	2017	77%	Flat
Sweden	Overall	2019	85%	Variable
Denmark	PET	2019	94%	Variable
Estonia	PET	2017	87%	Flat
Finland	PET	2016	92%	Variable
Germany	PET	2015	98%	Flat
Iceland	PET	2014	87%	Flat
Lithuania	PET	2017	92%	Flat
Norway	PET	2018	89%	Variable
Sweden	PET	2019	84%	Variable

Source: London Economics' analysis based on scheme operators' publications and CM consulting and reloop (2018). 'Deposit Systems for One-Way Beverage Containers: Global Overview.'

Annex 2 Consumer Survey

A2.1 Consumer survey

The survey was designed around two primary objectives:

- To collect data on demand response to changes in drinks prices; and
- To collect data on the probabilities that consumers return containers under different deposit fees.

A sample of 2500 adults aged between 18-65 were surveyed online. To survey the relevant demography, screening questions were included in the survey to ensure that all respondents have bought single and/or multipack of soft drinks.

A2.1.1 Survey questions on elasticity

In general, the demand for drinks of different sizes is likely to respond to prices differently. For example, the demand for a small can of cola may be more sensitive to price changes than a multipack of cans.

The survey therefore uses three sets of questions to collect information on elasticities separately for different sized drinks. In each set of questions, the respondents were asked to imagine choosing between plastic and can(s) to buy a drink at different prices. The drink is small in the first set. Respondents were asked to imagine buying a drink between 300ml and 500ml. The drinks are larger in the second and third set, 2 litres and 8 litres.

To illustrate, Table 20 presents the question set for medium sized drinks from the survey.

Table 20 Question set for medium sized drinks

Imagine that now you are looking to buy a larger beverage portion, about 2 litres. You have the choice to buy a multipack of 6 cans or a large plastic bottle. Again, both options give you the same amount of beverage. In the next four questions, you will make the same choice facing different prices. Q8. Would you rather buy a multipack of 6 cans at £4 or a 2 litre plastic bottle at £2 to purchase the same amount of drink? (Select best match) Multipack of 6 cans at £4 2 litre plastic bottle at £2 Indifferent Neither Q9. Would you rather buy a multipack of 6 cans at £5.20 or a 2 litre plastic bottle at £2 to purchase the same amount of drink? (Select best match) Multipack of 6 cans at £5.20 2 litre plastic bottle at £2 Indifferent Neither Q10. Would you rather buy a multipack of 6 cans at £4 or a 2 litre plastic bottle at £2.20 to purchase the same amount of drink? (Select best match) Multipack of 6 cans at £4 2 litre plastic bottle at £2.20

Indifferent Neither Q11. Would you rather buy a multipack of 6 cans at £4 or a 2 litre plastic bottle at £2.50 to purchase the same amount of drink? (Select best match) Multipack of 6 cans at £4 2 litre plastic bottle at £2.50 Indifferent Neither

Below explain the purposes that each question in Table 20 serves.

1) First question (Q8 in Table 20)
   a) The first question in each question set can be considered as the baseline question. The respondents were presented the baseline prices of both options – can and plastic. These prices represent the pre-DRS prices. Facing these baseline prices, the respondents had the option to buy the drink in cans or plastic. They could also choose neither or be indifferent between the two options.
   b) The responses in the question are used to estimate the pre-DRS demand.
2) Second question (Q9 in Table 20)
   a) In the second question, the can option increases in price by 20p per can while the price of the plastic option stays at the baseline price.
   b) Any differences in the survey responses between the baseline and this question represent the change in demand responding to the price increase of 1.20p on the 6 packs of cans.
   c) The change in responses is used to estimate:
      i) The change in demand for drinks in cans for every penny increase in the price of drinks in cans (own price elasticity effect).[54]
      ii) The change in demand for drinks in plastic bottles for every penny increase in the price of drinks in cans (cross price elasticity effect).[55]
3) Third question (Q10 in Table 20)
   a) In the third question, the price of the plastic option increases by 20p per bottle while the price of the can option remains the same as the baseline.
   b) Similarly, any differences in the survey responses between the baseline and this question represent the change in demand responding to a 20p price increase in each plastic bottle.
   c) The change in responses is used to estimate:
      i) The change in demand for drinks in cans for every penny increase in the price of the same drinks in plastic bottles (cross price elasticity effect).[56]

[54] This own price elasticity is calculated as the percentage change in the number of respondents choosing the can option divided by the percentage change in the price of the can option.

[55] This cross price elasticity is calculated as the percentage change in the number of respondents choosing the plastic option divided by the percentage change in the price of the can option.

[56] This cross price elasticity is calculated as the percentage change in the number of respondents choosing the can option divided by the percentage change in the price of the plastic option.

ii) The change in demand for drinks in plastic bottles for every penny increase in the price of drinks in plastic bottles (own price elasticity effect).[57]

4) Fourth question (Q11 in Table 20)

a) In the fourth question, the price of the plastic option increases by 50p per bottle, while the price of the can options is the same as the baseline. This question captures the extent that the price of a large drink would increase at the point of purchase, under the variable rate scheme.

b) Again, any differences in the survey responses between the baseline and this question represent the change in demand responding to a price increase of 50p in each large plastic bottle.

c) The change in responses is used to estimate:

i) The change in demand for drinks in cans for every penny increase in the price of the same drinks in plastic bottles (cross price elasticity effect).[58]

ii) The change in demand for drinks in plastic bottles for every penny increase in the price of drinks in plastic bottles (own price elasticity effect).[59]

The question sets for small and large sized drinks are similar to this set for medium sized drinks. Except respondents were asked to imagine choosing to buy the drink in different container sizes. The question set for small drinks also does not have the question where a price increases by 50p. This is because the deposit fees on small drinks are 20p in both the flat and variable rate schemes.

A2.1.2 Survey questions on return rate

Respondents were asked to imagine that they had bought a drink and paid a return fee for the drink container. The survey then asked them how likely they are to return the drink container at different levels of return fees. Three separate questions are used for three different container sizes, 330ml, 1L, and 2L.

Respondents were asked to indicate the likelihood of return on a 0-5 scale. 5 means that the respondent would return the container 5 out of 5 times and 0 means that the respondent would return the container 0 out of 0 times.

Responses choosing 5 out of 5 times are translated to a 100% return rate, 4 out of 5 times to a 80% return rate, 3 out of 5 times to a 60% return rate, 2 out of 5 times to a 40% return rate, 1 out of 5 times to a 20% return rate, and 0 out of 5 times as 0% return rate. The average return rate of respondents gives the estimated return rate for the container size at the given deposit fee level.

Table 21 presents the survey question for the 330ml container. The questions for 1L and 2L are the same as this question except the container is different in size.

[57] This own price elasticity is calculated as the percentage change in the number of respondents choosing the plastic option divided by the percentage change in the price of the plastic option.

[58] This cross price elasticity is calculated as the percentage change in the number of respondents choosing the can option divided by the percentage change in the price of the plastic option.

[59] This own price elasticity is calculated as the percentage change in the number of respondents choosing the plastic option divided by the percentage change in the price of the plastic option.

Table 21 Return rate question on the 330ml container

Q17. On a scale of 0-5, with 0 being never and 5 being always, how likely or unlikely are you to return a 330ml litre beverage container if you had paid the following refundable deposit fee?

	0 out of 5 times	1 out of 5 times	2 out of 5 times	3 out of 5 times	4 out of 5 times	5 out of 5 times
a 10p						
a 20p						
a 30p						
a 40p						
a 50p						

Annex 3 Overall change in demand for alcoholic drinks

The overall change in demand for alcoholic drinks cans is not affected by the estimated cross price elasticities. In other words, the model assumes no switching between PET and cans for alcohol. This is because within the scope of the study it was not possible to include questions on the demand for alcohol in the consumer survey.

In addition, we use the own price elasticities for soft drinks and increase them by 0.5 (in absolute terms) based on the literature (section 3.6).

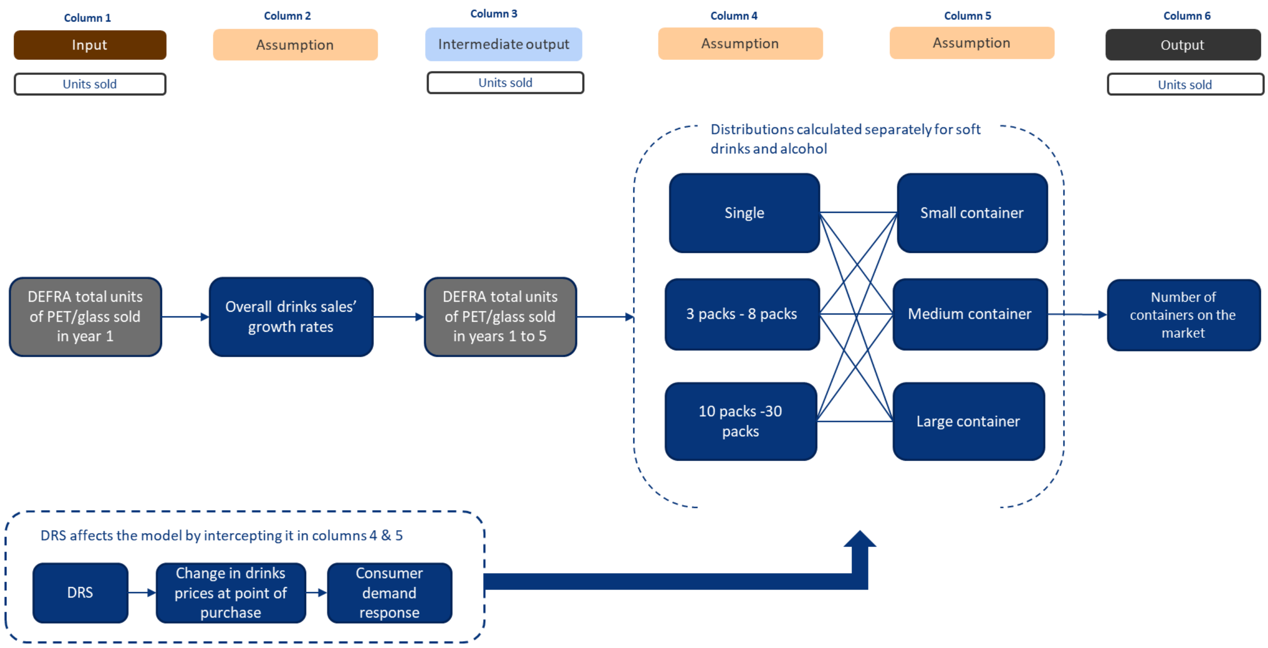
The table below presents the estimated change in demand for alcoholic drinks under a flat rate and variable rate DRS.

Deposit fee perceived as tax		
Affected consumers: those who do not return containers in scenario 1 and everyone in scenario 2		
	20p deposit fee changes demand by	Variable rate deposit fees change demand by
Drinks in small single cans	-45.78%	-45.78%
Drinks in small multipacks of small cans	-37.68%	-37.68%
Drinks in large multipacks of small cans	-37.12%	-37.12%
Price only increased by cost of effort		
Affected consumers: those who return container s in scenario 1 and everyone in scenario 3		
	1p value of effort changes demand by	
Drinks in small single cans	-2.29%	-2.29%
Drinks in small multipacks of small cans	-1.88%	-1.88%
Drinks in large multipacks of small cans	-1.86%	-1.86%
Portion of deposit fee perceived as tax		
Affected consumers: everyone in scenario 4		
	20p deposit fee changes demand by	Variable rate deposit fees change demand by
Drinks in small single cans	-15.11%	-15.11%
Drinks in small multipacks of small cans	-12.43%	-12.43%
Drinks in large multipacks of small cans	-12.25%	-12.25%

Annex 4 No-DRS baseline modelling logic for PET and glass

This annex explains the modelling logic for the estimation of the baseline demand for PET and glass under no-DRS, as presented in Figure 40. The estimates are calculated separately for the two packaging materials by applying the same calculation steps.

Figure 40 No DRS baseline logic for PET and glass



Source: London Economics

- **Column 1:** The model uses Defra's (2019) estimates of total units of PET and glass sold in the UK as the overall baseline demand in year 1.
- **Columns 2-3:** Using the UK drinks sales growth rates for years 2-5 estimated based on Statista's data for glass and PET for years 2020-2023[60], the total units of PET and glass are forecasted for the five years period following the DRS implementation.
- **Columns 4-6:** The total number of units of PET and glass sold over 5 year time period is then grouped into sales of small, medium, and large single containers. Similar to cans, containers less than 500ml are classified as small, between 500 and 999ml are classified as medium, and 1000ml or more are classified as large. The multipacks are grouped into small and large multipacks. Packs which contain 8 or less cans are classified as small packs. Packs which contain between 10-30 cans are classified as large packs. The model distinguishes between soft drinks and alcohol, to consider different packaging types found in these markets. The data is grouped based on Nielsen's Global Snapshot data for flavoured carbonates, beer and cider sales in Great Britain between September 19th 2019 and September 19th 2020[61].

[60] The growth rates for years 2020-2023 are calculated for the combined predicted sales of carbonated soft drinks, beer and cider in the UK found in Statista's Market Outlook reports (2020).

[61] Nielsen's data is not publicly available.

The bottom row in Figure 40 illustrates how the DRS intercepts the baseline. The implementation of the DRS changes drinks prices at the point of purchase. The sales of PET bottles in columns 4 and 5 will then change according to the price elasticities (see more section 3.6). Due to this study's limitations, the post-DRS demand for glass could not be estimated and is assumed to be equal to the no-DRS baseline demand (see more in section 4.4).

Annex 5 Modelling results for PET and glass

All the results in this annex are presented for Scenario 1. The results were used as inputs in the modelling of DRS financing (see more section 5.1).

A5.1 PET

A5.1.1 No-DRS baseline results

Table 22 Sales volume under no-DRS baseline scenario (million units sold, 5 year time period)

	Small single PET	Medium single PET	Large single PET	Small multipacks of small PET	Small multipacks of large PET	Large multipacks of small PET	Total
Carbonated soft drinks	20,302.41	1,058.20	23,665.08	1,075.74	11.16	1.89	**46,114.48**
Alcohol (beer and cider)	3.34	4,457.39	2,757.74	0.00	0.00	7.88	**7,226.35**
Total	**20,305.75**	**5,515.59**	**26,422.82**	**1,075.74**	**11.16**	**9.77**	**53,340.83**

Note: There are no small and large multipacks of medium sized PET bottles and large multipacks of large PET bottles.

Source: London Economics' calculations based on data from Defra (2019), Nielsen and Statista.

A5.1.2 Post-DRS results

Flat rate DRS

Table 23 Sales volume under flat rate DRS scenario (million units sold, 5 year time period)

	Small single PET	Medium single PET	Large single PET	Small multipacks of small PET	Small multipacks of large PET	Large multipacks of small PET	Total
Carbonated soft drinks	18,983.51	940.77	25,617.62	1,155.99	12.13	2.05	**46,712.06**
Alcohol (beer and cider)	2.86	3,464.09	2,747.53	0.00	0.00	7.03	**6,221.50**
Total	**18,986.36**	**4,404.85**	**28,365.15**	**1,155.99**	**12.13**	**9.08**	**52,933.56**

Note: There are no small and large multipacks of medium sized PET bottles and large multipacks of large PET bottles.

Source: London Economics' calculations based on data from Defra (2019), Nielsen and Statista.

Variable rate DRS

Table 24 Sales volume under variable rate DRS scenario (million units sold, 5 year time period)

	Small single PET	Medium single PET	Large single PET	Small multipacks of small PET	Small multipacks of large PET	Large multipacks of small PET	Total
Carbonated soft drinks	19,006.01	870.95	25,043.52	1,154.62	11.35	2.05	**46,088.50**
Alcohol (beer and cider)	2.87	3,059.03	2,680.32	0.00	0.00	7.04	**5,749.26**

Total	**19,008.88**	**3,929.98**	**27,723.84**	**1,154.62**	**11.35**	**9.09**	**51,837.76**

Note: There are no small and large multipacks of medium sized PET bottles and large multipacks of large PET bottles.

Source: London Economics' calculations based on data from Defra (2019), Nielsen and Statista.

A5.2 Glass

A5.2.1 No-DRS baseline results

Table 25 Sales volume under no-DRS baseline scenario (million units sold, 5 year time period)

	Small single glass bottles	Medium single glass bottles	Large single glass bottles	Small multipacks of small glass bottles	Large multipacks of small glass bottles	Total
Carbonated soft drinks	78.05	1.28	0.00	10.04	0.32	**89.70**
Alcohol (beer and cider)	7,302.11	3,060.75	157.40	5,295.19	12,025.12	**27,840.57**
Total	**7,380.16**	**3,062.04**	**157.40**	**5,305.23**	**12,025.44**	**27,930.27**

Note: There are no small and large multipacks of medium sized and large sized glass bottles.

Source: London Economics' calculations based on data from Defra (2019), Nielsen and Statista.

Due to the lack of sufficient evidence on own and cross price elasticities for drinks in glass bottles (in the literature and consumer survey[62]), the model does not estimate the post-DRS demand for drinks in glass. Therefore, the post-DRS demand estimation for glass bottles is assumed to equal the pre-DRS demand (i.e. there are no growth rates applied).

[62] The survey did not include any questions on consumers' demand for glass bottles due to a limit on the number of questions in the survey (demand for cans and PET was covered in more detail instead).

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