FINAL REPORT

Queensland Container Refund Scheme

Impacts on prices, consumers and competition

Prepared for
Queensland Productivity Commission

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THE CENTRE FOR INTERNATIONAL ECONOMICS
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Executive Summary

The Queensland Container refund scheme commenced on November 1st 2018. This scheme pays a ten-cent refund to consumers who return an eligible drink container, with the payments funded by a levy on suppliers of containers. The purpose of this report is to estimate whether the introduction of this scheme has had an impact on:

- the prices of eligible beverage containers purchased in Queensland,
- the costs to beverage suppliers, and whether the costs of supplying containers correspond to any observed price changes
- the quantity of beverages purchased for consumption in Queensland
- the amount of money spent by consumers on beverages in Queensland
- overall changes in the level of competition in the beverage market.

This work has been commissioned by the Queensland Productivity Commission and is designed to complement other analysis undertaken by the Commission as part of its price monitoring of the first twelve months of the scheme.

Datasets used

This analysis is conducted using a household level transactions dataset from Nielsen. The Nielsen 'Homescan' Panel provides data for households who scan their individual purchases of products, providing transaction data for each beverage purchased by the households. The household coverage is across all of Australia and includes monthly observations from January 2016 to September 2019.

The CIE has also used a database of beverage advertisements from the Drinks Association. This database records advertised prices of alcoholic beverage products by state over time. The coverage used in this analysis includes monthly observations from January 2016 to October 2019.

Estimated impacts of the CRS on expenditure and consumption

The main results from the analysis in this report are shown in table 1. We find that:

- non-alcoholic beverage prices have increased by 9 cents, which is close to the cost imposed on suppliers. There has also been a reduction in the litres of consumption of non-alcoholic beverages as a result of the CRS

  - this estimate is close to our previous estimate of 9.5 cents per container in our July report, which suggests that the price impact occurred near the start of the scheme and has not changed over time
- for alcoholic beverages, there is evidence of a positive price impact, however the estimated impacts vary across models and datasets. The estimated price impact ranges from 4.6 cents to 9.9 cents using the same model across two different datasets.
  - the gap between the two datasets has widened since our July report, which previously estimated a price impact of between 6.9 to 8.7 cents. The lower estimate from the Nielsen data is driven by revisions made by Nielsen to the historical series, rather than the CRS impact getting smaller over time.

1 Summary of conclusions

Sector	Prices	Consumption	Expenditure
Non-alcoholic beverages	Estimated increase of 9 cents per container or a 5.1 per cent increase in container prices. Price increases consistent with scheme costs.	Estimated reduction of 6.5 per cent or 1.04 L per household per month. The largest impacts (by volume) are from soft drinks, followed by water. Evidence of larger impacts for multi-pack products rather than single bottles.	Estimated increase of 4.3 per cent or 93 cents per household per month. These estimates are sensitive to econometric specification.
Alcoholic beverages	Estimated increase of 4.6 to 9.9 cents across different samples. Impacts vary across sample and specification.	No clear evidence of impacts.	No clear evidence of impacts.

Source: The CIE.

Price impacts

Our estimates show that the CRS has had an impact on the **prices** of eligible beverage containers for non-alcoholic beverages. The CRS has increased non-alcoholic beverage prices by 9 cents per container. This is primarily driven by higher prices for soft drinks and bottled water. This result is statistically significant. The impact is estimated to be almost the same for Brisbane and regional Queensland.

2 Impacts on the prices of non-alcoholic beverages

	Water	Soft drinks	Fruit juices	Small flavoured milks	Total
Estimated impact (cents per container)	8.0***	10.3***	3.8***	8.9***	**9.0*** **
Standard error	0.81	0.59	1.35	1.43	**0.47**
Implied percentage change	5.1%	8.0%	1.4%	4.2%	**5.1%**

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.

Source: CIE calculations.

For alcoholic beverages, two different data sources were used. The estimated impact across these datasets ranges from 4.6 cents per container to 9.9 cents per container. The price impacts were positive across both datasets, although consistently larger in the Drinks Association dataset. Overall, both datasets have smaller samples, making disaggregated analysis less reliable.

3 Impacts on the prices of alcoholic beverages

	Beer	Cider	Spirits (CRS)	Total
Nielsen dataset				
Estimated impact (cents per container)	4.8**	12.1**	4.4	**4.6****
Standard error	1.04	4.99	10.27	**1.10**
Implied percentage change	2.0%	4.4%	0.7%	**1.5%**
Drinks Association dataset				
Estimated impact (cents per container)	8.6***	16.2***	9.5***	**9.9*****
Standard error	0.73	2.91	1.71	**0.76**
Implied percentage change	4.0%	5.4%	2.5%	**3.7%**

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.
Source: CIE calculations.

The price impacts of the scheme were estimated using a fixed effects model, which can measure the change in eligible container prices while accounting for the variation in prices across different products, retailers and geographic location. While the model specification aims to account for the variation in prices not related to the scheme, there are some limitations.

- There are relatively small sample sizes for some beverage categories (particularly the alcoholic beverage categories):
  - the Nielsen Homescan Panel overwhelmingly comprises observations on non-alcoholic beverages, with alcoholic beverage observations comprising less than 10 per cent of the dataset
  - because the dataset is built from household observed transactions, the small sample size of alcoholic beverages means that it is more sensitive to changes in household sample rotation. While this would impact household level analysis (such as consumption and expenditure impacts) more strongly, the product level price analysis is also built up from fewer observations and is less reliable compared to the non-alcoholic analysis.
  - the small alcoholic beverage sample is represented in the average monthly expenditure on alcoholic beverages in the Homescan Panel, which is around 15 per cent of what is reported in the ABS Household expenditure survey, compared to over 60 per cent for non-alcoholic beverages
  - the Drinks Association ad-watch database, similarly has a small sample for alcoholic beverages, particularly for cider and spirits, making disaggregated analysis more challenging

– the Drinks Association ad-watch database is compiled from beverage advertisements and not sales. Meaning that price observations may not reflect as well the prices at which consumers actually bought beverages.

Consumption impacts

Additionally, the results show that the CRS has had an impact on the levels of consumption and expenditure of non-alcoholic beverages:

- the CRS has reduced **consumption** of non-alcoholic drinks by around 1 L (6.5 per cent) per household per month. This is primarily driven by reductions in soft drink and bottled water (table 4). This result (at the aggregate level) is statistically significant and robust to changes in model specification.
- these results are driven primarily by lower consumption of multipacks, rather than single beverages.

4 Estimated impact of the CRS on consumption of non-alcoholic beverage types

	Water	Soft drinks	Fruit juices	Small flavoured milks	Total
Estimated impact (Litres)	-0.32**	-0.73***	0.02	~0	**-1.04*** **
Standard error	0.16	0.18	0.06	0.02	**0.25**
Implied percentage change	-9.8%	-7.6%	0.6%	-1.7%	**-6.5%**

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.

Source: CIE calculations.

The CRS has increased **expenditure** on non-alcoholic drinks by around 93 cents (4.3 per cent) per household per month, driven mainly by increases in soft drink expenditure (table 5). The expenditure impacts reflect the higher prices, partly offset by lower consumption. There is less certainty around the impact on expenditure compared to consumption, as the different beverage categories have less statistical significance placed on their estimates overall. The results are also more sensitive to different econometric specifications, with many of the other specifications yielding non-statistically significant impacts.

5 Estimated impact of the CRS on expenditure on non-alcoholic beverage types

	Water	Soft drinks	Fruit juices	Small flavoured milks	Total
Estimated impact ($)	0.22**	0.49*	0.14	0.07	**0.93*** **
Standard error	0.10	0.26	0.12	0.09	**0.33**
Implied percentage change	10.0%	3.8%	2.8%	5.7%	**4.3%**

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.

Source: CIE calculations.

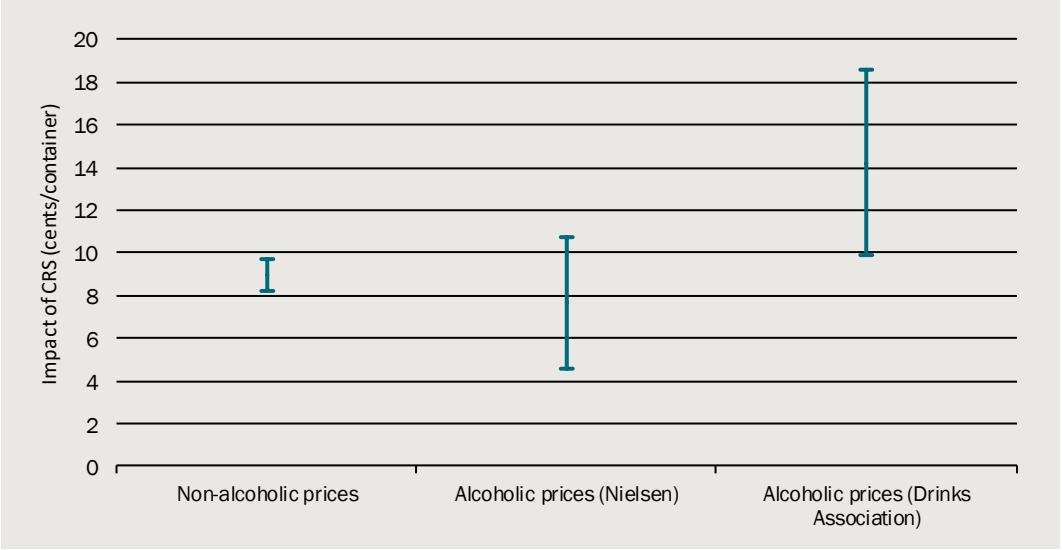
Sensitivity analysis

One way to test the reliability of the main conclusions above is to estimate the impact of the CRS using different modelling assumptions. This report conducts a sensitivity analysis with respect to:

- whether to use the rest of Australia as the 'control group' in the regression, or just a single state such as NSW and Victoria
- whether to allow seasonal trends that vary by state
- whether to fit a linear or logistic model (for consumption and spending impacts), and
- using different data sources (including Nielsen Homescan panel and the Drinks Association ad watch database).

The range of price impact estimates generated by changing these assumptions is shown in chart 6. As can be seen, the price impacts for non-alcoholic beverages are robust, with a range of 1-2 cents between the highest and lowest impact. Alcoholic price impacts are more variable, and while this suggests that alcoholic beverages experienced a positive price impact, there is less certainty on the precise magnitude of the change.

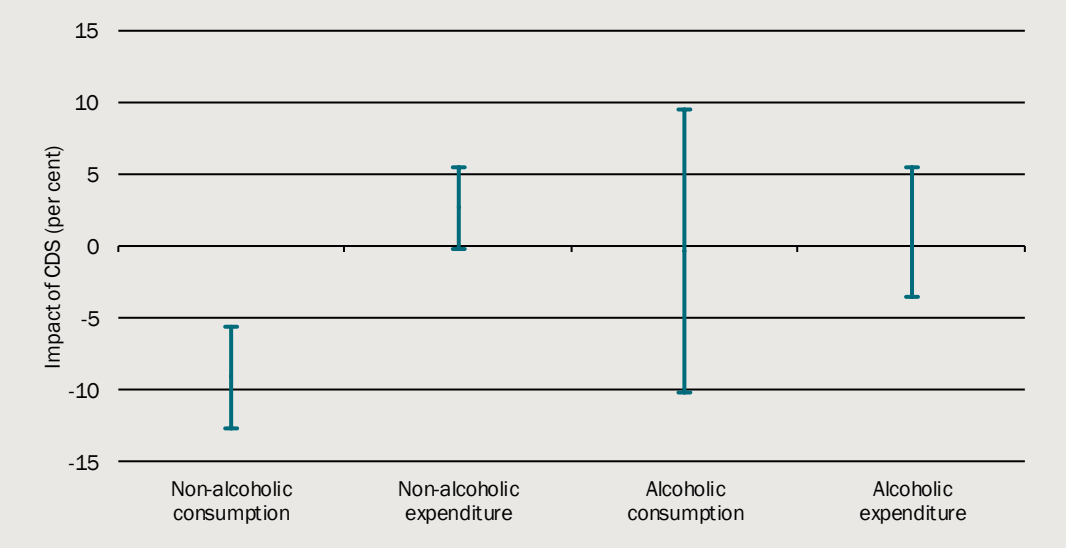
6 Sensitivity analysis to different modelling assumptions – price impacts



Data source: CIE calculations.

Sensitivity analysis is similarly performed for the impacts on beverage consumption and expenditure. The most robust finding is for non-alcoholic consumption, which consistently estimates a fall (chart 7). There is less certainty on the impact on expenditure, with several models not detecting statistically significant impacts (i.e. non-distinguishable from zero). The estimates for changes in alcoholic consumption and expenditure are extremely volatile and are presented in the appendix.

7 Sensitivity analysis to different modelling assumptions – other impacts



Data source: CIE calculations.

1 Introduction

The Queensland Container Refund Scheme (CRS), Containers for Change, commenced on 1 November 2018. This scheme allows for containers returned to collection points to earn a 10-cent refund and for containers recycled by materials recovery facilities (MRFs) to also receive a refund that will be shared between MRFs and local councils. The cost of the scheme, including the refund, is paid for at the point of (and by any entity responsible for) first beverage supply into Queensland.

What the CIE has been asked to do?

The Queensland Productivity Commission (QPC) has been asked by the Government to monitor and report on the impact of the implementation of the Container Refund Scheme (CRS) on container beverage prices over its first twelve months of operation. In particular, QPC will monitor and report on:

1 the effect of the CRS on prices of beverages sold in Queensland in an eligible container,

2 the effect of the CRS on competition for beverages and the performance and conduct of manufacturers and retailers,

3 any other specific market impacts on consumers that arise from the commencement of the scheme, and

4 any other matters which are relevant to the consumer interest.

To inform this reporting process, QPC has asked the Centre for International Economics to conduct a quantitative analysis that identifies:

- the price impact of the CRS on eligible beverage containers, for both alcoholic and non-alcoholic beverages
- the impact of the CRS on consumer spending on alcoholic and non-alcoholic beverages, including:
  - whether there is an observed change in quantity consumed and/or money spent on beverages in each section of the beverage market
  - whether this varies by geographic region
  - whether this varies by beverage category, or between different sizes of beverages.
- the extent to which the beverage prices have responded to the scheme (i.e. how price increases compare with the costs of the scheme)

This analysis is conducted using three data sources:

- the Nielsen Homescan Consumption Panel, which tracks the consumption behaviour of a representative sample of Australian households
- the Drinks Association Ad-watch database, which tracks listed alcoholic beverage advertised prices for different beverage types
- administrative data from Container Exchange (CoEx), which includes the total quantity of each type of beverage sold in Queensland by each supplier.

The analysis contained in this report is designed to complement any other analysis being conducted for the QPC in its review of the CRS.

Expected impacts of the CRS

Expected price impacts

The CRS imposes a direct cost on businesses that supply beverages (referred to as manufacturers) in eligible containers into Queensland. This cost has been set to recover the refunds expected to be paid to customers and the administrative costs of the scheme. The extent to which the CRS charge is passed through to consumers depends on a wide range of factors. As a general rule, the share of CRS passed through to consumers of beverages will be higher where:

- demand for beverages is not very responsive to price
- supply of beverages is highly responsive to price.

Market structure will also influence the degree of passthrough. In general, a higher degree of market power would mean that firms are less able to pass on the full cost, since prices would already be set to their highest level while still being able to retain customers. In contrast, competitive markets would mean that most of the cost increase would be passed through, as no individual firm would be able to absorb the cost and still remain in business.

The impacts of the CRS on prices would be expected:

- to occur at different points in the supply chain depending on the entry of containers into Queensland. For example, a manufacturer in Queensland should increase their price by the fee amount. However, a wholesaler who purchases in another state (i.e. Victoria) and then distributes into Queensland would not pay a higher amount to the Victorian manufacturer (since a container refund scheme is not in place). Instead, the wholesaler would be charged scheme prices for the supply of containers into Queensland
- to be similar in magnitude to the scheme container prices charged to first suppliers in a competitive market, unless there are substantial compliance and administrative costs borne by beverage suppliers directly, in which case the price increases could be higher
- to be marginally different for different container types as fees vary by type of material

- to differ in their percentage impact depending on the price of the product that is being sold. For example, a $2 bottle facing a 10 cent higher cost is a 5 per cent price increase, while for a $4 bottle this increase is only 2.5 per cent.

Expected consumer response

With respect to consumer behaviour, consumers may change their patterns of beverage consumption as a result of the CRS. These changes will be driven by:

- The extent to which the CRS levy is passed through the beverage supply chain to consumers
- The extent to which these price increases are perceived as real price increases – i.e. to what extent is the retail price increase of beverages offset by the refund from container returns.

The interactions between these two forces could lead to unique outcomes regarding overall demand for beverages in Queensland. Under a scenario with full participation in 'Containers for Change', any passthrough of the CRS charge would be largely offset by the refunds. In this case, the price increase would be neutralised, and it would be reasonable to expect little change in consumer patterns regarding beverages. Alternatively, for customers who do not participate in Containers for Change, CRS passthrough would constitute a real price increase, and, depending on overall sensitivity to price increases, this could lead to a decrease in demand for beverages. This could be the case for households who find it costly to participate in Containers for Change due to a lack of nearby collection facilities.

Theoretically, we would expect that:

- the CRS would increase the price of beverages, as some part of the CRS levy is passed through to consumers
- in response, consumers would reduce the amount of consumption of CRS-eligible products
- the overall impacts of the CRS on a household's expenditure on beverages could go up or down depending on which of the above impacts is larger
  - if the reduction in consumption is proportionally larger than the increase in prices, then expenditure would fall. For example, if prices increase by 5 per cent and quantity consumed falls by 10 per cent, the expenditure on beverages will fall
  - if the reduction in consumption is proportionally the same as the increase in prices, then expenditure would remain the same
  - if the reduction in consumption is proportionally smaller (inelastic, but not perfectly inelastic) than the increase in prices, then expenditure would increase

In practice, however, the impacts expenditure and consumption can vary and will depend on the relative strengths of price sensitivity and participation in Containers for Change (chart 1.1).

1.1 Different impacts on consumption and spending

Elastic	Inelastic	Unit elastic
Decreased consumption	Decreased consumption	Decreased consumption
Decreased spending	Increased spending	Unchanged spending

Source: CIE Illustration.

The changes in consumer purchasing patterns may not occur immediately. There may also be complicated responses to the CRS within beverage types. For example, people may substitute to larger products, because these have a lower proportional CRS levy — a 1.5L soft drink has the same CRS charge as a 0.5L soft drink.

Within different regions there could also be different effects. This could partly reflect the income levels or demographic characteristics that vary between regional and metropolitan areas. However, it could also reflect design elements of the CRS. For instance, if people in regional areas were typically further away from a collection depot, then they may be more likely to reduce consumption following the introduction of the CRS.

The empirical approach

The main empirical approach used in this report to estimate the impact of the CRS is a fixed effects regression model using household level consumption and expenditure data from the Nielsen Homescan Consumer Panel (box 1.2).

The intuition behind this approach is that it compares beverage prices and the behaviour of households before and after the introduction of the CRS in Queensland in addition to a control group (the rest of Australia, which has since not experienced a policy change). If for instance, most beverage prices in Queensland increases (compared to the control group) following the introduction of the CRS, then the model will identify this change as the impact of the CRS. Likewise, if the control group observed decreases in prices but Queensland does not, this would also reflect an impact of the CRS, since the behaviour of prices deviated from what is considered a close comparator.

The main challenges with this approach are:

- noisy underlying consumption data: This is particularly the case with alcohol consumption data which has significantly fewer observations than non-alcoholic consumption data
- seasonal trends in the beverage market: If there is a strong seasonal trend in beverage consumption that coincides with the introduction of the CRS (such as people tending to drink more in summer) and it is not accounted for, then it will impact on the estimated impact of the CRS.

This analysis better accounts for the impacts of seasonality, as a longer time series was used compared to the draft report in June.

1.2 The fixed effects regression model

The impact of the CRS on beverage prices, consumption and expenditure is estimated using a fixed effects regression model. The main specification of this model is:

$$Y_{it} = \alpha_i + \beta_{1t} + \beta_2 CRS*Qld_{it} + u_{it}$$

Where:

- Y_{it} is the predicted variable, which include monthly prices of eligible beverage containers at the retailer and state level.
  - for consumption and expenditure model, this represents household level consumption and expenditure across the different beverage types
- α_i is a product/retailer/state level fixed effect that estimates the different price levels of the different beverages across retailers and geographic location.
  - for the consumption and expenditure model, this is a household level fixed effect that accounts for heterogeneity among the different households in the dataset.
- β_{1t} is a time-based fixed effects that capture general trends in prices/consumption/expenditure of beverages across Australia.
- $CRS*Qld_{it}$ captures the effect of the CRS. It is a dummy that occurs among the different beverage products and retailers in QLD after the start of the CRS.
  - for the consumption and expenditure model, this is a dummy that occurs among the different households in QLD
- u_{it} is the error term

The model is estimated on a monthly household panel which is generated from the Nielsen data, and is estimated independently on each beverage type.

For the price analysis, frequency weights are also applied to the sample to better represent the types of beverages actually consumed by households. More popular beverages are weighted higher based on the frequency of transactions observed in the dataset, compared to relatively infrequently consumed beverages.

Interpreting the results

This report estimates the impact of the CRS on a range of outcomes in the beverage market and some of these results are more reliable than others. In general, results are more reliable where they are:

- **Statistically significant**. Estimates in the report are reported with a measure of statistical significance. This is a technical measure of whether the estimate is likely to be a systematic impact of the CRS, as opposed to being generated by chance. Our report measures the magnitude of significance at the 10 per cent (*), 5 per cent (**) and 1 per cent (***) significance levels. An estimate will be statistically significant if most beverage prices (and households for the consumer analysis) show impacts in the same direction. While statistical significance is a very useful measure of model

accuracy, it does have limitations. For instance, the statistical significance of a result is typically driven by the sample size, and so it is much more likely that the estimates will be statistically significant for larger consumption categories, even if the impact was the same across categories. A statistically significant result could be found (or not found) also depending on whether there was another factor omitted from the analysis that occurred at the same time as the CRS. For example, if there was particularly hot weather since the CRS was introduced that led to greater beverage consumption across a lot of households, then this could show up as a statistically significant increase from the CRS.

- **Robust to modelling assumptions:** The estimation of the impact of the CRS is conducted using a fixed effects regression, and the estimated impact of the CRS can be impacted by the setup of this model. The appendix to this report tests the sensitivity of the main results to these modelling choices.
- **Relatively stable across time periods**. This report estimates the impact of the CRS by month. If the estimates are relatively stable across the analysis period, it is a sign that the estimates are relatively reliable.
- **Consistent with economic theory.** In some cases, the model generates results that are at odds with economic theory (for instance, in the alcohol section, the modelling suggests that the CRS is responsible for a decrease in some alcoholic beverage prices). In such cases, it is highly likely that the result is due to noise in the underlying data, rather than the CRS resulting in lower prices.

The results in this report are typically better estimated for non-alcoholic beverages, while smaller sample sizes mean that the estimates for alcoholic beverages and analysis of smaller market categories is typically less reliable.

2 Data sources

This report analyses the impact of the CRS using a household level transactions dataset for beverages as well as an alcoholic drinks Ad database. This chapter describes the datasets in detail and identifies their strengths and weaknesses.

Nielsen Homescan Consumer Panel

The Nielsen Homescan Panel survey collects data on household consumption for 10 000 households across a wide variety of product categories. Survey participants scan the barcode of the products that they purchase which are combined with retail price data to create a panel dataset of consumption data.

For this study, the transaction level data for all beverage products purchased from January 2016 – September 2019 have been used. This data includes:

- a detailed description of the product purchased (e.g. Coca Cola Value Pack 30x375ml)
- the price that was paid
- the retailer
- the data of the transaction
- the location of the transaction (broken down into 14 regions within Australia)

For this study, these transactions were grouped into six categories, which are shown in table 2.1 below.

2.1 Observed purchases in the Homescan data set

Type	Total observations in Homescan data (all states and territories)	Observations in QLD	Observations since CRS started in November 2018
Beer	69 205	13 987	3 160
Wine	121 219	19 771	4 573
Spirits	13 409	2 050	493
Water	172 879	35 315	8 146
Soft drinks	867 059	189 830	47 819
Fruit juices	498 141	100 738	23 965
Small flavoured milk	88 228	26 953	7 153
Total	**1 830 140**	**388 644**	**95 309**

Source: CIE calculations.

The Homescan survey is designed to capture products that are purchased at a retail outlet for consumption at home. Therefore, the data does not contain information on beverages purchased through other channels, including:

- beverages purchased through the hospitality sector (such as bars and cafes)

- beverages purchased and consumed away from home (such as a drink purchased at a petrol station)
- beverages purchased by groups other than households (such as businesses)
- beverages consumed but not scanned for any other reason.

One way to test what proportion of the beverages market is covered by the Homescan Dataset, is to benchmark the average level of expenditure across product categories with the observed consumption level from the ABS household expenditure survey (chart 2.2).

2.2 Observed expenditure in the Homescan data set and the Household expenditure survey

	Average expenditure in the Homescan Panel (Queensland)	Average expenditure from the ABS household expenditure survey	Nielsen as a share of ABS
	$/household/month	$/household/month	Per cent
Beer	5.3	31.2	17
Wine	5.0	32.5	15
Spirits	5.7	16.7	34
Water	2.2	5.9	37
Soft drinks	13.0	15.6	83
Juice	5.0	9.5	53
Total	**39**	**111.3**	**32**

Note: Alcohol consumption reported from the Household expenditure survey is based on off-licence consumption and would therefore also exclude purchases in the hospitality sector.

Source: Nielsen; ABS Household Expenditure Survey, Cat. No. 6530.0.

An important attribute of the data is that monthly consumption is equal to zero for many beverage types across the range of households sampled. The dataset records transactions for a wide variety of different beverages, with almost 40 per cent of transactions on other beverage types (non-CRS containers). As can be seen in table 2.3, around 30 per cent of transactions were for soft drinks. This would imply that in any given month, up to 70 per cent of households would not be consuming soft drinks and instead be consuming other beverages. The frequency of alcoholic beverage purchases such as beer is much smaller in the dataset compared to non-alcoholic beverages. While this largely reflects the reality that alcohol purchases are less common across the population than non-alcoholic purchases, it is also likely to represent some under-sampling in this area. This feature of the data is also important for econometric design.[1]

1 This is particularly important when deciding whether to fit a linear or log model. Without adjustment, a log model will drop zero observations, and while there are options that can be used to include zeros in the model, they typically perform poorly with such a high proportion of zeros in the sample.

2.3 Frequency of observations across the beverage categories

Beverage type	Share of observations
	per cent
Soft drinks	30
Water	6
Fruit juice	17
Small flavoured milk	3
Beer	2
Wine	4
Spirits	2
Other beverages	36

Source: Nielsen Homescan Panel and CIE calculations.

Revisions to historical dataset

Nielsen has advised QPC and the CIE that various revisions have been made to the historical series. Nielsen has stated that they have added additional data for alcoholic beverages with the aim of improving the quality of the alcoholic beverage sample. These changes impact the previous estimate of the price impact to June 2019, since there are roughly 20 000 additional beer observations (a 50 per cent increase on the previous dataset) as well as over 500 extra households in the Homescan panel.

Drinks Association Ad-watch dataset

The Ad-watch dataset is a service that collects and collates retail drinks advertising on a daily basis across metropolitan, regional and suburban newspapers and catalogues. The service also reports the advertised prices on a range of alcoholic beverages, including beer, cider, wine and spirits. This analysis used monthly observations on beverage advertisements ranging back to January 2016.

Characteristics included in the ad-watch database include:

- a detailed description of the advertised product
- the advertised price
- the retailer (e.g. BWS)
- the date of the listed advertisement
- the location of the advertisement (including by state and various regions within the state).

Table 2.1 provides an overview of the number of observations within the dataset, by beverage type and state. The number of observations is higher than the number of alcoholic beverage observations in the Nielsen dataset, particularly for beer (~247 000 observations compared to ~69 000 in the Nielsen sample).

2.4 Observed advertisements in the Ad-watch dataset

Type	Total observations in Ad-watch data (all states and territories)	Observations in QLD	Observations since CRS started in November 2018
Beer	247 788	58 302	18 113
Spirits	98 995	25 407	8 107
Cider	33 700	5 219	1 925
Total	**380 483**	**88 928**	**28 145**

Source: CIE calculations.

3 Impacts on beverage prices

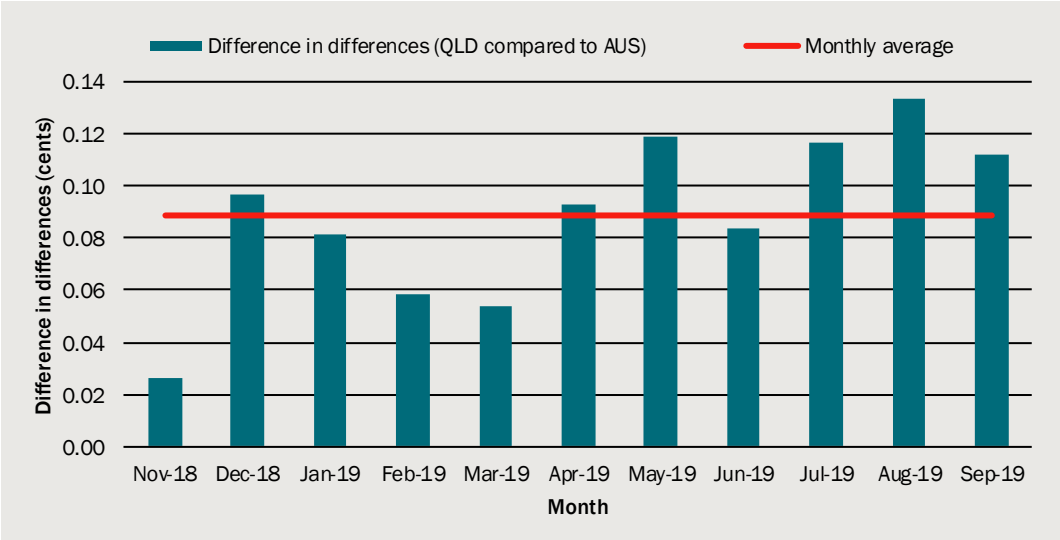
- **Econometric modelling of the different beverage products provides evidence of a price increase in eligible beverage containers as a result of the container refund scheme.**
- **The estimated price increase across all non-alcoholic beverages is 9 cents per container, which equates to a 5.1 per cent increase in prices.**
  - **the price increases were strongest for the most popular drink categories such as soft drinks and bottled water, which increased by 10.3 cents and 8 cents per container respectively**
- **The estimated price increases across all alcoholic beverages ranges from 4.6 cents to 9.9 cents per container (using two different datasets)**
  - **both datasets suggest an increase in alcoholic beverage prices, although the variability in the estimates places some uncertainty on the precise magnitude.**
- **The prices of individual containers that are part of multipacks also increased by similar amounts, although price increase as a percentage of container prices are higher for multipack containers, as they are cheaper compared to single container beverages.**
- **The price increases for non-alcoholic and alcoholic beverages across Brisbane and Regional Queensland are very similar, meaning that there is little evidence to suggest the scheme has different impacts across Queensland.**
- **Econometric modelling does not find sufficient evidence to suggest that the price impact of the scheme varies by retailers of different size.**

Changes in average beverage prices

Utilising a panel dataset on household level beverage purchases, it is possible to identify the average prices paid for beverages in each month before and after the implementation of the CRS in Queensland and other states. By comparing the behaviour of beverage prices to the other states, which have not since implemented a similar scheme to the CRS, it is possible to analyse differences in average beverage prices since the introduction of the CRS in Queensland.

Chart 3.1 is the net difference between the year on year change in average non-alcoholic beverage prices in Queensland and the rest of Australia. For example, in December 2018, prices in Queensland rose by 8 cents, whilst prices in the rest of Australia fell by 2 cents, the net difference is a 10-cent increase in the average price per container. On average (over the eleven months), this analysis suggests a that the price per container is 9-cents higher in Queensland than the previous year since the introduction of the CRS.

3.1 Difference in differences – year on year change in non-alcoholic prices



Data source: The CIE, based on Nielsen data.

This graphical analysis provides an overview of the broad changes in non-alcoholic beverage prices in Queensland and Australia. However, on its own, it is unclear whether the changes in consumption are due to the CRS or just due to natural variation in the underlying data. It is also possible that the impact of the CRS could be obscured by changes in the composition of beverages purchased over time (e.g. to more expensive beverages). The formal analysis in the following section is based on the same intuition as this graphical analysis but is designed to better isolate the impact of the CRS through more rigorous statistical tests.

Estimated price impacts across beverage types

This section presents the main modelling results of the impact of the CRS on beverage prices in Queensland. The results are reported by each of the main beverage types covered by the scheme, as well as by different container size (i.e. multipack products). The price estimates are also reported at the container level, as opposed to the product level to enable a more consistent estimate of price change (since some products are sold as multipacks and would therefore experience price increases by a multiple of the scheme price per container[2]). The price changes can also be compared to the average beverage container price of each of the different beverage types in table 3.2.

2 For example, if the scheme price per container was 10 cents, a single container would experience a price increase of 10 cents, while a 10 pack would increase by 1 dollar.

3.2 Average beverage prices per container (pre-CRS)

Beverage type	Price
	$/container
Non-alcoholic	
Soft drinks	1.3
Water	1.6
Fruit juices	2.7
Small milks	2.1
Alcoholic	
Beer	2.5
Wine	10.7
Spirits	6.6
Cider	2.7

Source: The CIE, based on Nielsen dataset.

The model indicates that the CRS has increased non-alcoholic beverage prices by 9 cents per container, which equates to a 5.1 per cent increase in the average price of a non-alcoholic beverage (table 3.3). This model considers the impact of the CRS on average in the first year of the scheme, while controlling for non-scheme related impacts on prices in Queensland and in other states.

The price increase varies slightly across the different beverage types. Soft drinks prices rose by 10.3 cents per container while bottled water and small flavoured milk prices rose by 8 cents and 8.9 cents per container respectively. Fruit juices experienced the smallest price increase, and this was 3.8 cents per container.

3.3 Impacts on non-alcoholic beverages

	Water	Soft drinks	Fruit juices	Small flavoured milks	Total
Estimated impact (cents per container)	8.0***	10.3***	3.8***	8.9***	**9.0*** **
Standard error	0.81	0.59	1.35	1.43	**0.47**
Implied percentage change	5.1%	8.0%	1.4%	4.2%	**5.1%**

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.

Source: CIE calculations.

The results for alcoholic beverages using the Nielsen dataset would indicate that prices are 4.6 cents higher on average. Across the different beverage types, this is mainly driven by beer (4.8 cents higher per container) and cider (12.1 cents per container) (table 3.4). Wine was also included for comparison purposes and does not appear to be impacted by the scheme. The alcoholic beverage estimates are lower compared to our July report, which estimated a 6.9 cent increase. This is not due to the CRS impact getting smaller over time, but rather due to revisions which were made by Nielsen to the historical series. These revisions also imply a smaller price impact in past months.

3.4 Impacts on alcoholic beverages – Nielsen dataset

	Beer	Wine (non-CRS)	Cider	Spirits (CRS)	Total
Estimated impact (cents per container)	4.8***	13.3	12.1**	4.4	**4.6*** **
Standard error	1.04	5.87	4.99	10.27	**1.10**
Implied percentage change	2.0%	1.2%	4.4%	0.7%	**1.5%**

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.

Source: CIE calculations.

The impacts on alcoholic beverages were also tested using an alternate source of data from the Drinks Association, as the sample size from the Nielsen dataset is smaller for alcoholic beverages. Using another dataset provides a means of validating the results under different conditions (table 3.5). The results from this dataset are slightly higher than the Nielsen sample, with the price per container estimated to have increased by 9.9 cents. This estimate more closely aligns to the Nielsen estimates for non-alcoholic beverages.

Across the different beverage types, the Ad-watch dataset shows larger impacts compared to the Nielsen dataset. In particular, there is a statistically significant impact on spirit prices compared to a non-significant increase from the Nielsen dataset. The relatively smaller samples for cider and spirits in both datasets is a limitation of the analysis.

3.5 Impacts on alcoholic beverages – Drinks Association dataset

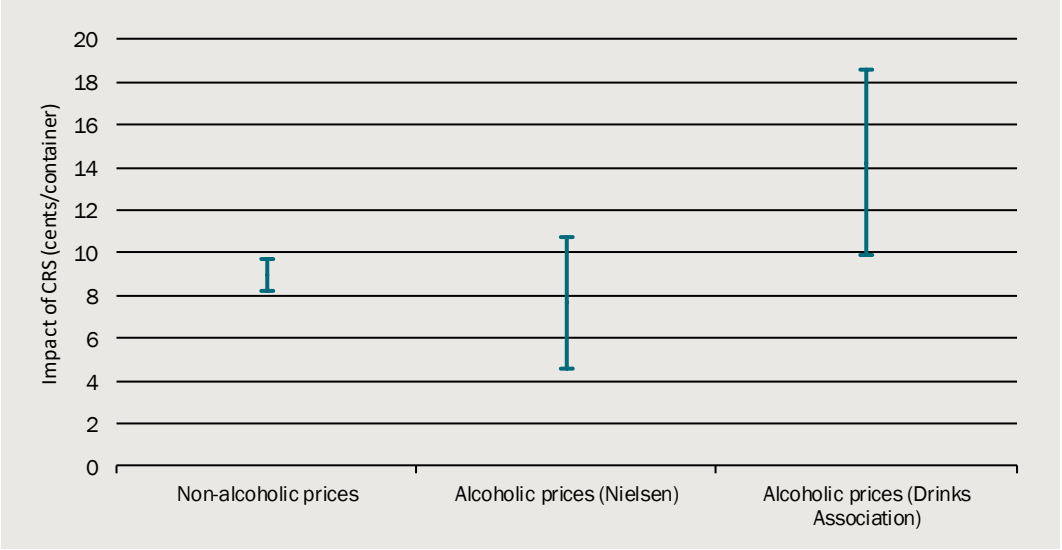
	Beer	Cider	Spirits (CRS)	Total
Estimated impact (cents per container)	8.6***	16.2***	9.5***	**9.9*** **
Standard error	0.73	2.91	1.71	**0.76**
Implied percentage change	4.0%	5.4%	2.5%	**3.7%**

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.

Source: CIE calculations.

Chart 3.6 shows the sensitivity of the aggregate results to different modelling specifications, as well as across the different alcoholic beverage datasets. The results for non-alcoholic price impacts are not sensitive to specification, while the results for alcoholic price impacts vary by a larger degree. This variation across specification occurs across both the Nielsen datasets and the Drinks Association Ad-watch datasets. This would seem to indicate that alcoholic beverages have experienced a price increase, although there is less certainty on the precise magnitude of the change.

3.6 Sensitivity analysis to different modelling assumptions – price impacts



Data source: CIE calculations.

Impacts on containers which are part of multipacks

The price impact per container can be separately estimated depending on whether the container was part of a multipack product. The price increases of multipack containers would mean that the price of the total product (for example a case of beer) would increase by more than standalone container products (such as a 2-litre soft drink). To estimate the price effects consistently, prices are measured at the per container level.

As can be seen in table 3.7, containers which are part of multi pack products have observed similar price increases to the estimated averages above.

- soft drink containers across different sized packs have increased by between 10 and 11 cents per container, while water containers have increased by a similar magnitude, with the exception of single container water beverages
- the price impact as a percentage of the container price is higher for multipacks, since the average price per container is typically lower in larger multipacks (see table 3.8). This is especially true for water, which has a considerably cheaper unit price in 25 to 40 packs compared to standalone bottles.

Estimates for juice and small milk beverages were excluded due to the sample sizes being insufficient for container size disaggregation.

3.7 Impacts on non-alcoholic multipack containers

Container type	Soft drinks (price change)	Soft drinks (percentage change)	Water (price change)	Water (percentage change)
	cents/container	per cent	cents/container	per cent
Single pack	11.2***	7.5	1.7	0.8
2-9 pack	10.2***	10.3	9.9***	11.2
10-24 pack	10.2***	18.1	9.4***	33.3
25-40 pack	10.7***	18.2	11.4***	50.9

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.

Source: CIE calculations.

3.8 Average price per container – non-alcoholic beverages

Container type	Soft drinks	Water
	$/container	$/container
Single pack	1.5	2.0
2-9 pack	1.0	0.9
10-24 pack	0.6	0.3
25-40 pack	0.6	0.21

Source: The CIE.

The results for alcoholic beverages are more varied and not always consistent with economic intuition, which would not predict a decrease in price for some products.

The most reasonable finding would be for beer containers part of 10 to 24 packs and 25 to 40 packs, which were estimated to have increased by 8.7 and 6.3 cents per container respectively (table 3.9). Most results, however, are not statistically significant. Disaggregated analysis for alcoholic beverages using the Nielsen data is harder due to the limited sample size.

Estimates for cider beverages were excluded due to the sample sizes being insufficient for container size disaggregation.

3.9 Impacts on alcoholic multipack containers

	Beer (price change)	Beer (percentage change)	Spirits (price change)	Spirits (percentage change)
	cents/container	per cent	cents/container	per cent
Container type				
Single pack	74.5	10.1	-6.5	-0.2
2-9 pack	12.8	5.1	7.6	1.9
10-24 pack	8.7***	4.9	9.1*	2.7
25-40 pack	6.3***	4.4	na	na

Source: The CIE.

Price impacts by region

The price impact per container can also be estimated at the regional level. The price impacts could differ if the direct costs of the scheme, such as the administrative and network costs (e.g. collection and transport of containers) differed across the regions. Alternatively, the relative price elasticities of supply and demand might be different across regional and urban areas (e.g. different consumer preferences towards beverages), leading to different proportions of price passthrough. The price impacts by region are presented in Table 3.10.

- The regional impacts for non-alcoholic beverages are very similar, with the price increase per container estimated at 8.9 cents in Brisbane and 8.8 cents in Regional

Queensland. The impacts across soft drinks and water are also close (within 1-cent of each other).

The regional impacts for alcoholic beverages were estimated using two datasets (the Nielsen Homescan dataset and the Drinks Association ad-watch dataset). The regional price impacts using the ad-watch dataset are also similar.

- The Nielsen dataset suggests a 6.3 cent increase for alcoholic beverages in Brisbane. In contrast, no statistically significant change was estimated for Regional Queensland. This is more likely due to the very limited sample size of the Nielsen alcoholic beverage dataset, making regional disaggregation challenging.
- The drinks association dataset suggests a 10.8 cent increase for alcoholic beverages in Brisbane, and a 9.4 cent increase for Regional Queensland. The estimates by beverage type also suggest that both regions have experienced price increases.

Note that the impacts for cider are less reliable, due to a small sample (around 5 200 across all of Queensland, with only 1 900 observations during the CRS period).

3.10 Price impacts by region

	Brisbane		Regional QLD	
	Cents/container	Standard error	Cents/container	Standard error
Non-alcoholic	**8.9*** **	**0.55**	**8.8*** **	**0.64**
Water	7.7***	0.93	8.4***	0.71
Soft drinks	10.4***	0.52	9.8***	0.72
Alcoholic (Nielsen)	**6.3*** **	**1.81**	**1.2**	**1.94**
Alcoholic (Drinks Association)	**10.8*** **	**0.95**	**9.4*** **	**0.87**
Beer	8.7***	0.89	8.8***	0.86
Spirits	11.2***	2.11	8.8***	1.98
Cider	17.2***	3.06	14.3***	4.48

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.

Source: CIE calculations.

Price impacts by retailer size

It is also possible to estimate the price impact per container across retailers of different sizes. This type of analysis would prove useful if there were reason to believe that the passthrough of scheme costs could vary by type of retailer. Table 3.11 presents the price impacts for large retailers (such as large supermarkets and liquor retailers) and small retailers (any retailer which is not characterised as a large retailer).

- For non-alcoholic beverages, the price per container sold at large retailers was estimated to have increased by 9 cents (which is equal to the main result for non-alcoholic beverages). For small retailers, the price estimate was a non-significant impact of near zero cents per container.

- Alcoholic beverage prices were estimated using the Nielsen dataset and the Drinks Association dataset. Both datasets suggest that prices have increased at both types of retailers. The price impact for large retailers ranges between 4.5 and 6.9 cents per container across datasets, while for small retailers this ranges from a non-significant 3.5 cents per container to 10.4 cents per container.

It is likely that the Nielsen estimates for small retailers are less robust due to the fact that most households (around 95 per cent) in the dataset purchase beverages from larger retailers (such as supermarkets), which limits the number of observations at other sized retailers. In contrast, the Drinks Association dataset tracks advertisements, and these advertisements are more even in their coverage of different sized retailers (around a 60/40 split in terms of small to large).

The result for non-alcoholic beverages is non-conclusive, due to the low reliability of the small retailer results. While the individual retailer point-estimates suggest that smaller alcoholic beverage retailers have increased beverage prices more than large retailers, statistical tests do not find the price difference to be statistically significant[3].

3.11 Price impacts by retailer size

	Large retailer		Small retailer		Significantly different
	cents/container	Standard error	cents/container	Standard error	Yes/no
Non-alcoholic	9.0***	0.46	~0	7.84	No
Alcoholic (Nielsen)	4.5***	1.61	3.5	4.24	No
Alcoholic (Drinks Association)	6.9***	1.67	10.4***	0.89	No

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.

Source: CIE calculations.

Price impacts in Queensland compared to other states

Overall, estimated price increases are similar to other states, particularly New South Wales (table 3.12). Like Queensland, the price impacts estimated by IPART were of a similar magnitude across the non-alcoholic beverage categories. The price impacts estimated by the ICRC for ACT are higher overall, however this may be due to the fact that ICRC estimated the impacts on wholesale container prices, rather than retail prices.

3 To reduce uncertainty around the retailer level results, an additional model was estimated, which measures the scheme impact on large retailers compared to small retailers jointly. This coefficient was not statistically significant from zero.

3.12 Comparison of price impacts to NSW and ACT

Beverage type	Queensland (Nielsen)	Queensland (Drinks Association)	NSW	ACT
Beverage type	cents/container	cents/container	cents/container	cents/container
Non-alcoholic	**9.0**	**na**	**10.1**	**12.2**
Water	8.0	na	11.6	12.2
Soft drinks	10.3	na	10.8	12.2
Fruit juices	3.8	na	5.3	11.9
Small flavoured milks	8.9	na	na	na
Alcoholic	**4.6**	**9.9**	**5.1**	**12.7**
Beer	4.8	8.6	4.2	12.8
Cider	12.1	16.2	10.0	12.7
Spirits (ready to drink)	4.4	9.5	6.9	12.4

Note: Estimates rounded to the nearest cent.

Source: The CIE, IPART: NSW Container Deposit Scheme, Monitoring the impacts on container beverage prices and competition, final report December 2018, page 2, ICRC: Container Deposit Scheme price monitoring, final report August 2019, p28.

4 Price impacts compared to scheme costs

The container refund scheme (CRS) operates as a combination of a tax on suppliers of beverages, along with a refund paid to consumers who return a container. However, the ultimate incidence of the CRS depends on the extent to which producers are able to pass through the cost of the CRS levy to consumers. The extent to which the costs of the scheme are passed through to consumers depends on the overall competitiveness of the market, as well as overall supply and demand elasticities.

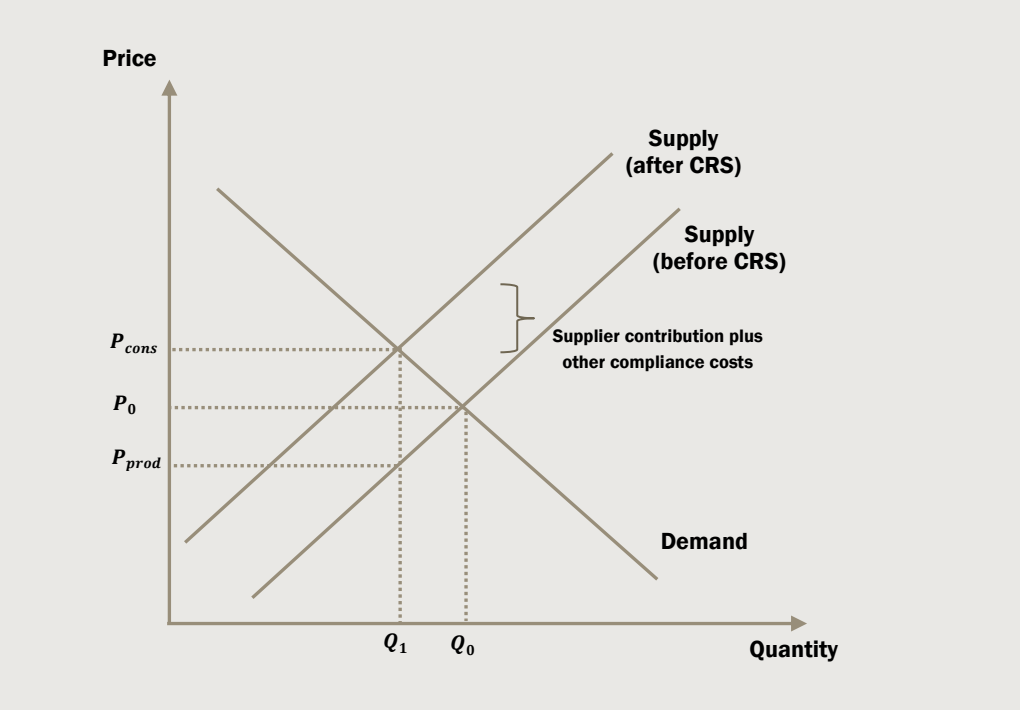
Pass through of CRS costs in a supply and demand framework

The simplest way to display the incidence of the CRS is to use a simple supply and demand framework. In this framework, the demand curve represents the quantity of container beverages that would be purchased at various prices, while the supply curve represents the quantity that producers would be willing to sell at each price. Market equilibrium occurs where the supply and demand curves intersect.

In this setting, the costs of the CRS act as a tax on supply, which manifests as a shift in the supply curve (chart 4.1), since it is more expensive to supply containers. This shift includes the per container levy as well as other compliance and administration costs associated with the scheme.

This increases the equilibrium price and reduces the equilibrium quantity of containers in the market. Consumers bear P_{cons}-P_0 of the tax, while producers bear P_0-P_{prod}.

4.1 The demand-supply system

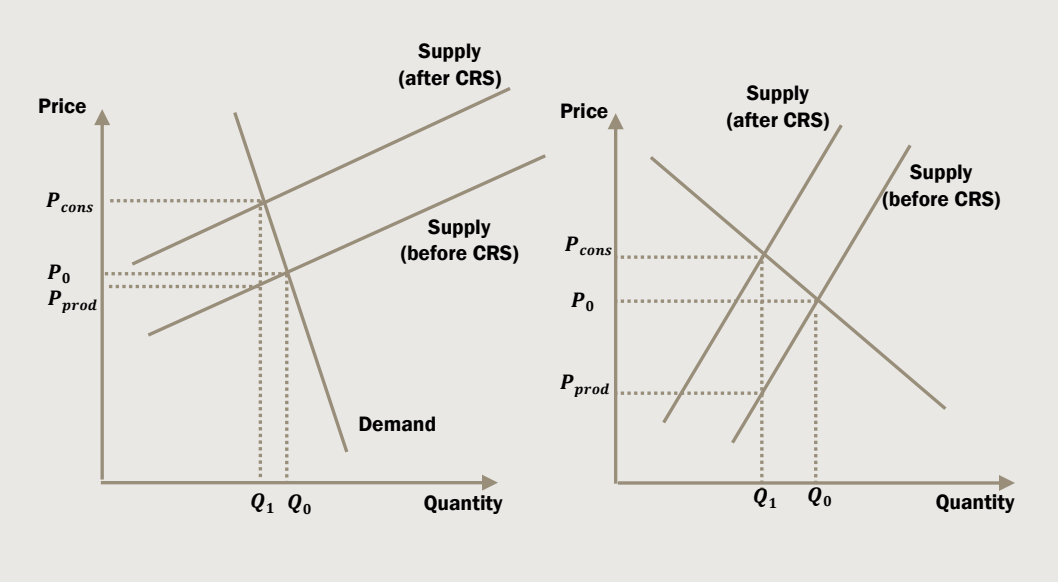


Data source: CIE illustration.

In this framework, the main determinant of whether the scheme costs is borne by producers or passed through to consumers is the elasticity of supply and demand.[4] (In the diagrams, a flat supply or demand curve is elastic, while a steep supply or demand curve is inelastic). This can be clearly seen in figure 3.8. In the left-hand panel, supply is elastic (flat) and demand is inelastic (steep) and as a result, consumers end up bearing most of the burden of the scheme costs. In the right panel, demand is relatively elastic, while supply is inelastic, and producers end up bearing most of the tax.

4 This can be shown formally, where the share of a tax borne by consumers is equal to $E_S/(E_S+E_D)$, while the share borne by producers is equal to $E_D/(E_S+E_D)$.

4.2 The CRS is more likely to fall on the inelastic side of the market



Data source: CIE Illustration.

What affects supply and demand elasticities?

Demand elasticities are largely determined by the availability of substitutable products. Where consumer choice is high, consumers are likely to respond to price increases by decreasing the quantity consumed of higher priced products and shift to cheaper products. This could be the case for substitution away from CRS containers to beverages not covered by the CRS (e.g. a move from beer to wine). Inelastic demand however refers to a lack of choice, where consumers would not so readily change their behaviour in response to price increases. Beverage consumers would in this case, incur a higher proportion of scheme costs.

The elasticity of supply is determined by a range of factors related to how easily a firm is able to adjust its output such as length and complexity of production, ability to store output and the availability of inputs to production. For example, if production complexity is high and it takes a long time to bring products to market, then supply will be relatively inelastic, since it cannot readily increase and decrease in response to price change.

The beverage manufacturing industry is relatively competitive, with lots of producers and a large variety of products. In a competitive setting, most of the costs of the scheme would be expected to be passed on to consumers.

The role of market power on cost pass through

The degree of market concentration can also affect how much of the CRS charge will be passed through to consumers. In general, a greater degree of market power will imply a smaller proportion of the tax is passed through to consumers. This occurs because in the absence of a tax a monopolist will be able to charge a higher price than in a competitive

market, and a tax reduces the ability of a supplier to extract monopoly rent. In other words, some of the incidence of the tax falls on the monopolist's mark-up.

However, as shown in table 4.3, different market structures will result in differing levels of pass-through, and it is therefore difficult to predict from first principles how the market structure of the beverage industry will impact the way that the CRS levy is passed through the supply chain.

Larger suppliers may also be better placed to handle the administrative costs of the CRS. For instance, where there is a one-off fixed cost of understanding and complying with the scheme, larger suppliers will be able to spread this cost across a larger product base. Therefore, it is possible that the impact on smaller manufacturers will be different to larger players.

4.3 Pass through of taxes under different theoretical market structures

Market structure	Incidence of taxes
Perfect competition	Full pass through, or less than full pass though, depending on supply and demand elasticities
Monopolistic competition	Full pass through
Bertrand Duopoly	The same as perfect competition
Cournot Duopoly	Less than full pass through, full pass through or greater than full pass through are all possible
Monopoly	Less pass through than under perfect competition

Source: Institute of Fiscal Studies 2011. 'A retrospective evaluation of the elements of the VAT system: full report to the European Commission', page. 286.

Comparing scheme costs to actual price increases

The total scheme cost per container comprises:

- the direct administrative and network costs to operate the scheme per container (e.g. collection, baling and transport), and
- the average refund paid per container which is determined by the recovery rate for containers.

The scheme price charged to beverage suppliers varies over time as well as by material type. Since the start of the scheme in November 2018 till October 2019, the weighted average price charged by CoEx per container was 10.2 cents (ex GST) and 11.2 cents (including GST) (table 4.4). Compared to an estimated price increase of 9 cents per container for non-alcoholic beverages and between 4.6 to 9.9 cents per container for alcoholic beverages (including GST), this would suggest that the price increases were less than the scheme costs in the first year of the scheme.

4.4 Scheme container price per material type

Container type	1 Nov 2018 - 31 Oct 2019	1 Nov 2019 onwards
	Cents (excl. GST)	Cents (excl. GST)
Aluminium	9.9	11.2
Glass	10.5	11.9
HDPE	10.6	11.9
PET	10.3	11.8
LPB	10.6	12.1
Weighted average cost per container	**10.2**	**11.6**

Source: The CIE, QPC.

Cost and revenue breakdown for returned containers

The Container Exchange (CoEx) annual report provides information on what the costs of operating the scheme were in the 2018-19 financial year[5]. The annual report can be used to estimate the scheme costs and revenue on a per container returned basis, although it should be noted that the costs incurred during the first year of operation may not be representative of a typical year. For example, costs could be higher due to the establishment costs incurred by CoEx during its first year of operation. These costs may fall in future years.

The annual report specifies a range of different cost components which can broadly be defined as:

- refund costs – these are the costs incurred for container refunds to both individuals as well as material recovery facilities (these amount to $54.8 million and $23.6 million respectively)
- non-refund costs – which cover all of CoEx's expenses that were not related to refund costs, such as the cost of container collection points, transport and logistics, marketing as well as business expenses (these amount to $90.8 million).

In order to present these costs (as well as revenue) on a per container returned basis, we calculate an estimate of the number of returned containers over the period. This involves dividing refund costs of $78.4 million by the refund rate of 10 cents per container, resulting in 783.7 million returned containers. Using this, we estimate that the total scheme cost per returned container is 21.6 cents, of which 11.6 cents is for non-refund costs (table 4.5).

The 11.6 cents per container for non-refund scheme costs is potentially higher than it normally would be in a typical year of operation, even if the total costs incurred during 2018-19 are representitive. This is because CoEx was established prior to the commencement of the scheme (which launched November 2018), the organisation would have been incurring operating expenses before container returns were possible. In future years, the cost per container could reduce, since the non-refund scheme costs would be spread over a larger number of returned containers (i.e. a full year's worth of returned containers).

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4.5 Breakdown of scheme cost and revenue per container

	Total	Per returned container
	$million (ex GST)	cents/container (ex GST)
Refund costs	78.4	10.0
Non-refund scheme costs	90.8	11.6
Total cost	169.2	21.6
Total revenue	194.6	24.8

Note: To calculate cost and revenue per returned container, the totals are divided by 783.7 million containers

Source: The CIE based on information from the Container Exchange Annual report, 2018-19, p41

The per-container non-refund scheme costs should be calculated in future years to provide a reliable estimate of the costs of the Container Refund Scheme. This figure should also be tracked over time to understand how efficiently the scheme is being run.

5 *Impacts on non-alcoholic beverage consumption and expenditure*

- **Econometric modelling of the individual non-alcoholic beverage categories is supportive of the CRS reducing consumption (in litres). The reduction in consumption is a consistent finding across different model specifications, while the impacts on expenditure vary from zero to positive.**
- **The estimated magnitude of the reduction in consumption across all non-alcoholic beverages is 6.5 per cent**
  - **the most consistent finding is impacts for soft drinks, which showed statistically significant falls in consumption. These results were robust to sensitivity tests and different model specifications.**
- **The impacts of the CRS were estimated at the container size level. As large multi-packs of beverages are typically cheaper per beverage, the CRS is a larger proportional share of the original product price and may therefore be more impacted. Evidence suggests that the largest reductions in consumption occurred for multi-packs of soft drinks.**
- **Similar responses to the scheme were estimated across regions. The results suggest falls in consumption of and rises in expenditure on non-alcoholic beverages in both Brisbane and Regional Queensland. This suggests that the scheme is having a consistent impact across the state.**
- **Econometric modelling does not find sufficient evidence to suggest that the scheme has led to different consumption and expenditure responses at different sized retailers.**

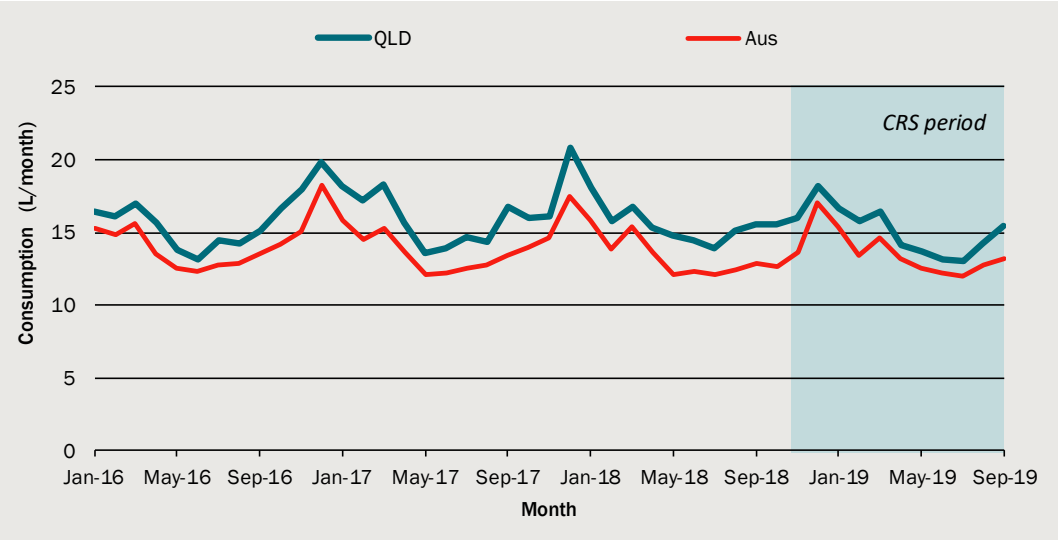
Change in average household consumption and expenditure

Using the same panel dataset on household spending and consumption patterns for the price analysis, it is possible to track a sample of households across different geographic locations in Queensland over time. By comparing the behaviour of households in Queensland to the rest of Australia (the counterfactual), it is possible to analyse differences in average household behaviour towards non-alcoholic beverages since the introduction of the CRS in Queensland.

As can be seen, consumption and expenditure levels on non-alcoholic beverages in Queensland has fluctuated over time (chart 5.1 and 5.2). Most notable is the similarity in the profiles of households in Queensland with households in the rest of Australia, including during seasonal months such as December, which is associated with a yearly

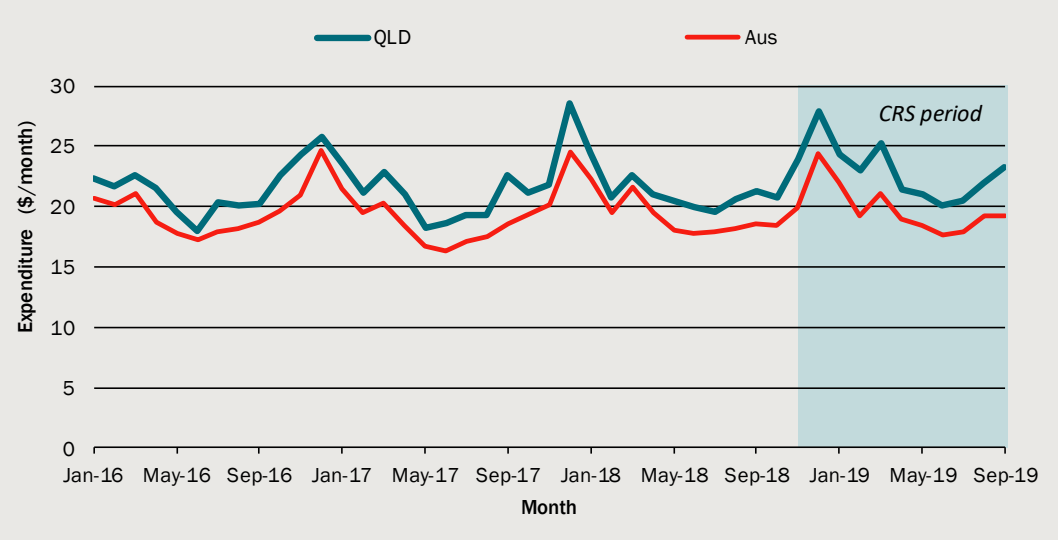
peak in spending and consumption followed by falls in January. The time series track closely together over time, suggesting that households in other states represent a good 'control group' for the estimation of the impact of the CRS.

5.1 Average household consumption of non-alcoholic beverages – 2016-19



Data source: Nielsen Homescan.

5.2 Average household expenditure on non-alcoholic beverages – 2016-19



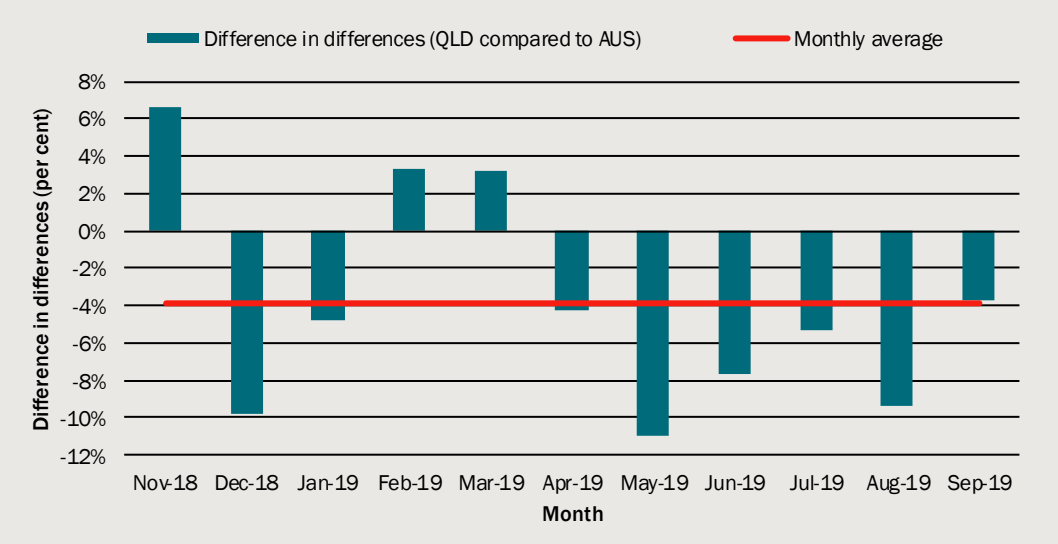
Data source: Nielsen Homescan.

The time series indicates that Queensland is compared against a good control group for this analysis. Chart 5.3 is the net difference between the year on year change in consumption in Queensland and the rest of Australia. For example, in December 2018, consumption in Queensland fell by 13 per cent, whilst consumption in other states fell by 3 per cent, the net difference is a 10 per cent fall. Not all months reflect falls, however, with the average change for the first year of the scheme at around 4 per cent.

As this analysis only considers broad averages however, more sophisticated analysis is needed to control for non-CRS related impacts on consumer behaviour. The formal

analysis in the following section is designed to better isolate the impact of the CRS through more rigorous statistical tests.

5.3 Difference in differences – year on year change in consumption



Data source: CIE analysis, Nielsen Homescan.

Changes in household spending and consumption by beverage type

This section presents the main modelling results of the impact of the CRS on non-alcoholic beverage consumption and expenditure in Queensland. The results are reported by beverage category. They are also estimated as the change in dollars (expenditure) and change in litres (consumption), which can be compared to the average pre-CRS household figures in table 5.4.

5.4 Average QLD household consumption and expenditure pre-CRS – Non-alcoholic

Product type	Expenditure	Consumption
	$/household/month	L/household/month
Fruit juices	4.98	2.72
Soft drinks	12.99	9.67
Water	2.22	3.25
Small flavoured milks	1.25	0.28

Source: CIE analysis based on Nielsen Homescan data.

The CRS has reduced consumption of non-alcoholic drinks by around one litre (~6.5 per cent) per household per month. This is driven primarily by reductions in soft drink (table 5.5).

5.5 Estimated impact of the CRS on consumption of non-alcoholic beverage types

	Water	Soft drinks	Fruit juices	Small flavoured milks	Total
Estimated impact (Litres)	-0.32**	-0.73***	0.02	~0	-1.04***
Standard error	0.16	0.18	0.06	0.02	0.25
Implied percentage change	-9.8%	-7.6%	0.6%	-1.7%	-6.5%

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.

Source: CIE calculations.

The CRS has increased expenditure on non-alcoholic drinks by around 93 cents (4.3 per cent) per household per month (table 5.6). There is less certainty around the impact on expenditure compared to consumption, as the different beverage categories have less statistical significance placed on their estimates overall.

5.6 Estimated impact of the CRS on expenditure on non-alcoholic beverage types

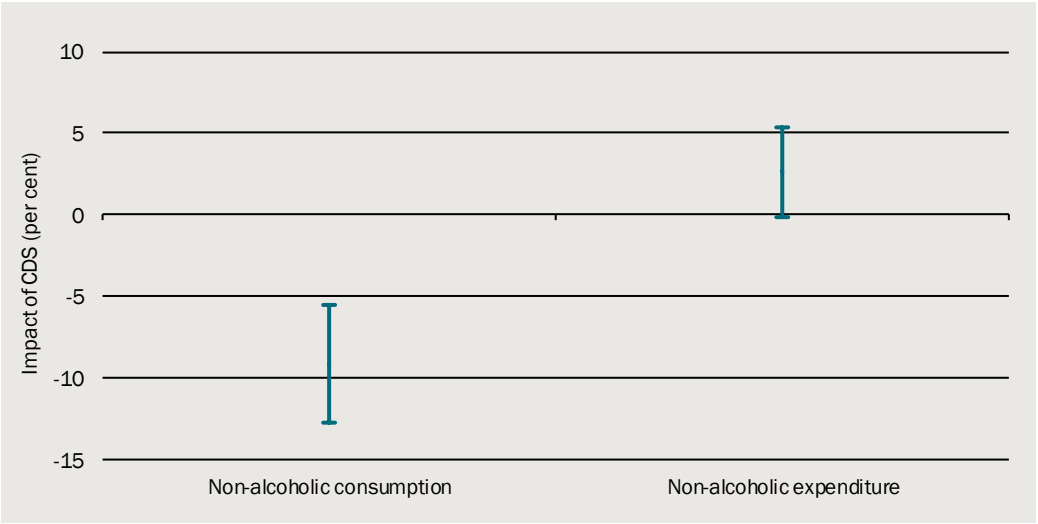
	Water	Soft drinks	Fruit juices	Small flavoured milks	Total
Estimated impact ($)	0.22**	0.49*	0.14	0.07	0.93***
Standard error	0.10	0.26	0.12	0.09	0.33
Implied percentage change	10.0%	3.8%	2.8%	5.7%	4.3%

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.

Source: CIE calculations.

If we model the impact of the CRS on aggregate non-alcoholic beverage consumption and expenditure, using different model specifications (see Appendix A), the reduction in consumption is robust to model specification changes (chart 5.7). The impacts on expenditure range from zero to positive, however only two of the models yield statistically significant results. This suggest that there is less evidence that expenditure has changed as a result of the CRS, while we can be more confident in a reduction in consumption.

5.7 Impacts of the CRS on non-alcoholic beverages across different models



Data source: The CIE.

Impacts by beverage container size

Another potential impact of the CRS is to generate substitution between beverage categories. This may occur because the CRS levy is charged at the same rate for different bottle sizes and will therefore increase the relative attractiveness of larger bottles, and because multi-packs are typically cheaper per beverage and hence are proportionally more impacted by the CRS levy. For instance, it is possible that people will consume fewer 30 packs of soft drinks (which are charged the CRS levy 30 times) and consume more large bottles of soft drink (which are charged the CRS levy once).

The majority of consumption of water and soft drinks is either single beverages or 10-24 packs (table 5.8).

5.8 Consumption by product type (pre-CRS)

Container type	Soft drink Consumption	Soft drink Expenditure	Water Consumption	Water Expenditure
	L/household/month	$/household/month	L/household/month	$/household/month
Single pack	4.87	5.25	1.12	1.19
2-9 pack	0.41	1.24	0.18	0.14
10-24 pack	2.78	4.04	1.93	0.88
25-40 pack	1.61	2.46	0.02	0.01
Total	**9.67**	**12.99**	**3.25**	**2.22**

Source: CIE based on Nielsen Homescan data.

To test for this effect, the fixed effects model is re-run with products differentiated by different container sizes. Due to limitations on the number of observations across the beverage types, this analysis is limited to soft drinks and bottled water (table 5.9).

Of note is the relatively stronger impact on larger multipack products for soft drinks and water of 10-24 packs and 25-40 packs. For soft drinks, consumption is estimated to have fallen by 14.1 and 11.4 per cent respectively (at the 1 and 5 per cent significance levels), while for water in 10-24 packs consumption fell by 17.3 per cent (at the 5 per cent significance level). There is less evidence to suggest a change in expenditure across the different multipack types, with positive but non-statistically significant estimates.

5.9 Estimated impact of the CRS by container size

	Soft drinks (level change)	Soft drinks (percentage change)	Water (level change)	Water (percentage change)
	L/household/month	Per cent	L/household/month	Per cent
Consumption				
Single pack	-0.15	-3.0	-0.01	-1.0
2-9 pack	-0.01	-2.0	0.02	11.8
10-24 pack	-0.39***	-14.1	-0.33**	-17.3
25-40 pack	-0.18**	-11.4	na	na
Expenditure				

	Soft drinks (level change)	Soft drinks (percentage change)	Water (level change)	Water (percentage change)
	L/household/month	Per cent	L/household/month	Per cent
Single pack	0.13	2.5	0.06	4.7
2-9 pack	0.12	9.8	0.04*	30.1
10-24 pack	0.09	2.2	0.12*	13.5
25-40 pack	0.15	6.2	na	na

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.

Source: CIE calculations.

Impacts by region

An additional consideration with respect to the impact of the CRS is geographic coverage. The degree of price change and sensitivity to such price changes may differ across the state, due to different preferences and the degree of product choice. Also, participation in Containers for Change is a determinant of whether price increases are seen as real price increases (since participating in the scheme would offset part or all of the price increase) and this could be different across regions.

Overall, consumption appears to have fallen in both Brisbane and Regional Queensland by similar amounts. Likewise, the estimates show an increase in expenditure across both regions. These results suggest that the scheme is having a similar impact across the state.

5.10 Impacts by region

	Brisbane		Regional Queensland	
	L/household/month	Per cent	L/household/month	Per cent
Consumption				
Non-alcoholic	-1.06***	-6.8	-1.01**	-6.1
Soft drink	-0.85***	-9.1	-0.46	-4.4
Bottled water	-0.27	-8.0	-0.44*	-14.9
Expenditure				
Non-alcoholic	0.75**	3.6	1.35**	5.9
Soft drink	0.21	1.7	1.16**	8.2
Bottled water	0.23*	10.0	0.20	10.2

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.

Source: CIE calculations.

Impacts by retailer size

The impact of the CRS on consumption and expenditure can similarly be estimated by retailer size. This means that it is possible to estimate whether consumer behaviour towards higher prices is different towards retailers of varying sizes and types (e.g. supermarkets versus convenience stores). If the consumption and expenditure impacts are

different, then this could suggest that a particular subset of beverage retailers have been uniquely impacted by the scheme.

Table 5.11 presents the estimated changes in consumption and expenditure for non-alcoholic beverages. Like the main results, consumption was estimated to have fallen while expenditure was estimated to have increased at large retailers. In contrast, no statistically significant change was estimated at small retailers.

The results would suggest that consumers are buying less beverages at large retailers, while not changing their behaviour at small retailers. However, as mentioned previously, there is a small sample of observations at small retailers. More than 95 per cent of observations in the Nielsen dataset originate from large retailers such as supermarkets, making the small retailer result unreliable.

Based on this analysis, there is insufficient evidence to conclude that different sized retailers have been impacted differently by the scheme.

5.11 Impact by retailer size

Type	Unit	Large retailer	Small retailer
Consumption	L/household/month	-1.0***	0.1
	Standard error	0.2	0.0
	Per cent	-6.7	15.6
Expenditure	$/household/month	1.0***	0.1
	Standard error	0.3	0.1
	Per cent	4.7	7.8

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.
Source: CIE calculations.

Impacts on alcoholic beverages

The model was used to estimate the impact on changes in consumption and expenditure for alcoholic beverages, however, due to the small sample size, it was not possible to obtain robust estimates. The full suite of econometric results is presented in appendix A.

A Full econometric results and sensitivity checks

Consumption and expenditure detailed results

This report estimates the impact of the CRS on household consumption and expenditure using Nielsen Homescan Data and a fixed effects econometric model. However, when running econometric analysis, there are typically a number of modelling assumptions that need to be made. In this project, the main modelling decisions were:

- whether to use households in the rest of Australia as the 'control group' in the regression, or just an individual state such as NSW
- whether to allow seasonal trends that vary by state.[6]
- whether to fit a linear or logistic model.

In each case, there are arguments for and against each modelling decision. While the CIE believe that the main specification of the model is the best single estimate of the impact of the CRS, it is still informative to test whether the main results are robust to different modelling choices. To that end, this appendix contains the results from five alternative model specifications:

- Model 1 includes time and household fixed effects, and is estimated using data from Queensland and NSW
- Model 2 is the main model used in the report. It uses the same specification as model one, but includes data from households in all Australian states and territories
- Model 3 uses data from Queensland and NSW, but uses a state specific seasonal trend to account for potential variation in seasonality across states
- Model 4 uses data from all states and territories, and state specific seasonal trends
- Model 5 estimates the impact of the CRS using a log model, which estimates the impact of the CRS as a percentage change. This is converted to an absolute change in the table below to allow for a comparison between models
- Model 6 is a log model using data from all states and territories
- Model 7 includes time and household fixed effects, and is estimated using data from Queensland and Victoria
- Model 8 uses a state specific seasonal trend and data from Queensland and Victoria
- Model 9 is a log model using data from Queensland and Victoria.

In each case, the models were run for the aggregated categories of alcoholic beverages (beer, wine and spirits) and non-alcoholic beverages (water, soft drink and juice and small flavoured milks).

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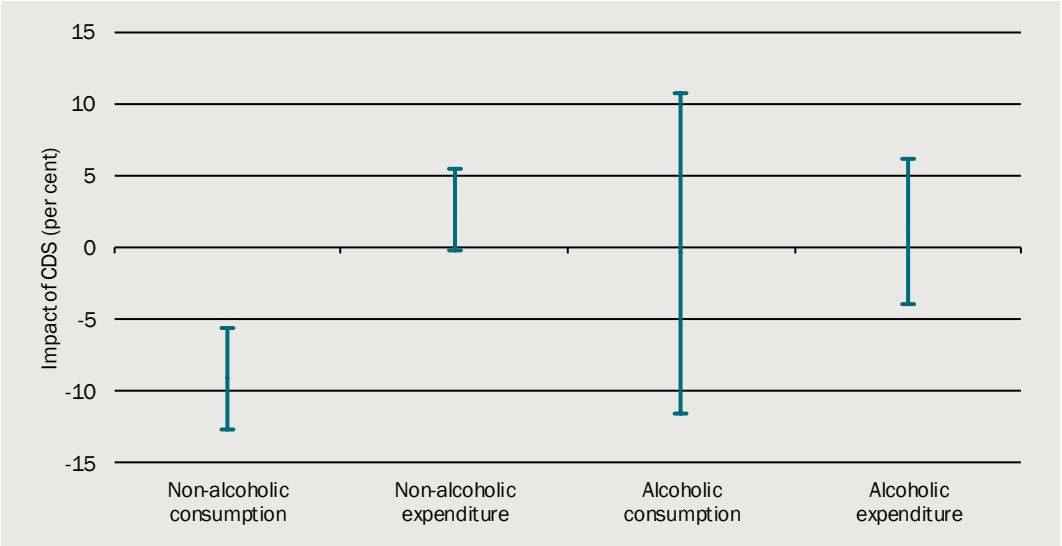
6 There data appears to show different seasonal trends in different states. However, allowing different seasonal trends in the model runs the risk of 'over-specifying' the model.

A summary of the point estimates from the alternative model specifications are shown in chart A.1. It should also be noted that this chart only shows the point estimate from these models, and does not show associated estimated confidence intervals. Adding this 'within model' variation would further increase the range of possible estimates generated by the models.

A.1 Estimates of the impact of the CRS under different model specifications



Data source: CIE Calculations.

Chart A.1 shows that:

- the result that the CRS has reduced consumption of non-alcoholic beverages is robust to options of model specification
- expenditure on non-alcoholic beverages is consistently positive for all specifications
- the results regarding alcoholic beverages are highly sensitive to model specification.

This interpretation is strengthened by observing the extended output from the 6 models in tables A.2 and A.3. This shows that the impact on non-alcoholic beverage consumption is negative and statistically significant in most models. The impact on expenditure consumption of alcoholic beverages and expenditure on alcoholic beverages are not statistically significant.

A.2 Sensitivity analysis – non-alcoholic beverages

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
	L/month	L/month	L/month	L/month	per cent	per cent	L/month	L/month	per cent
Consumption									
CDS impact	-0.93***	-1.04***	-1.52***	-1.52***	-8.92**	-12.72***	-0.89***	-1.52***	-11.57**
Standard error	0.26	0.25	0.24	0.24	0.05	0.04	0.28	0.24	0.05
Percentage change	-5.87	-6.53	-9.53	-9.53	na	na	-5.61	-9.53	na
Constant	16.58	15.99	16.00	14.85	8.09	8.01	15.78	15.12	8.02
Household fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Month	Month	State-specific	State-specific	Month	Month	Month	State-specific	Month
Comparison groups	QLD/NSW	QLD/Aus	QLD/NSW	QLD/Aus	QLD/NSW	QLD/Aus	QLD/VIC	QLD/VIC	QLD/VIC
F-statistic	38.99	72.68	59.78	59.78	42.66	38.99	37.18	61.64	37.86
F-test p-value	~0	~0	~0	~0	~0	~0	~0	~0	~0
N	206 668	385 859	206 668	385 859	206 668	385 859	176 964	176 964	176 964
	$/month	$/month	$/month	$/month	per cent	per cent	$/month	$/month	per cent
Expenditure									
CDS impact	0.69**	0.93***	0.64**	0.64**	0.81	-0.17	1.16***	0.64**	0.94
Standard error	0.35	0.33	0.31	0.31	0.02	0.02	0.37	0.31	0.02
Percentage change	3.24	4.32	2.97	2.97	na	na	5.41	2.97	na
Constant	22.44	21.56	21.50	20.20	2.48	2.44	21.02	20.50	2.43
Household fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Month	Month	State-specific	State-specific	Month	Month	Month	State-specific	Month
Comparison groups	QLD/NSW	QLD/Aus	QLD/NSW	QLD/Aus	QLD/NSW	QLD/Aus	QLD/VIC	QLD/VIC	QLD/VIC
F-statistic	41.77	74.46	52.41	52.41	63.32	117.06	33.67	55.34	53.50
F-test p-value	~0	~0	~0	~0	~0	~0	~0	~0	~0
N	206 668	385 859	206 668	385 859	206 668	385 859	176 964	176 964	176 964

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.

Source: CIE Calculations.

A.3 Sensitivity analysis – alcoholic beverages

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
	L/month	L/month	L/month	L/month	per cent	per cent	L/month	L/month	per cent
Consumption									
CDS impact	0.08	0.11	-0.24**	-0.24**	3.07	2.85	0.22	-0.24**	4.57
Standard error	0.12	0.13	0.11	0.11	0.04	0.03	0.20	0.11	0.04
Percentage change	3.52	4.47	-10.24	-10.24	na	na	9.46	-10.24	na
Constant	1.98	1.99	1.82	1.73	1.40	1.33	2.04	1.77	1.31
Household fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Month	Month	State-specific	State-specific	Month	Month	Month	State-specific	Month
Comparison groups	QLD/NSW	QLD/Aus	QLD/NSW	QLD/Aus	QLD/NSW	QLD/Aus	QLD/VIC	QLD/VIC	QLD/VIC
F-statistic	9.24	14.21	9.51	9.51	23.61	44.43	7.06	9.54	21.84
F-test p-value	~0	~0	~0	~0	~0	~0	~0	~0	~0
N	206 668	385 859	206 668	385 859	206 668	385 859	176 964	176 964	176 964
	$/month	$/month	$/month	$/month	per cent	per cent	$/month	$/month	per cent
Expenditure									
CDS impact	0.51	0.77	-0.64	-0.64	0.96	1.45	1	-0.64	2.07
Standard error	0.73	0.68	0.60	0.60	0.02	0.02	0.87	0.60	0.02
Percentage change	2.82	4.25	-3.55	-3.55	na	na	5.50	-3.55	na
Constant	15.37	14.53	14.17	13.44	0.65	0.62	14.47	13.34	0.61
Household fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Month	Month	State-specific	State-specific	Month	Month	Month	State-specific	Month
Comparison groups	QLD/NSW	QLD/Aus	QLD/NSW	QLD/Aus	QLD/NSW	QLD/Aus	QLD/VIC	QLD/VIC	QLD/VIC
F-statistic	12.06	20.81	11.94	11.94	23.60	44.02	9.83	12.92	21.80
F-test p-value	~0	~0	~0	~0	~0	~0	~0	~0	~0
N	206 668	385 859	206 668	385 859	206 668	385 859	176 964	176 964	176 964

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.

Source: CIE Calculations.

Price impact detailed results

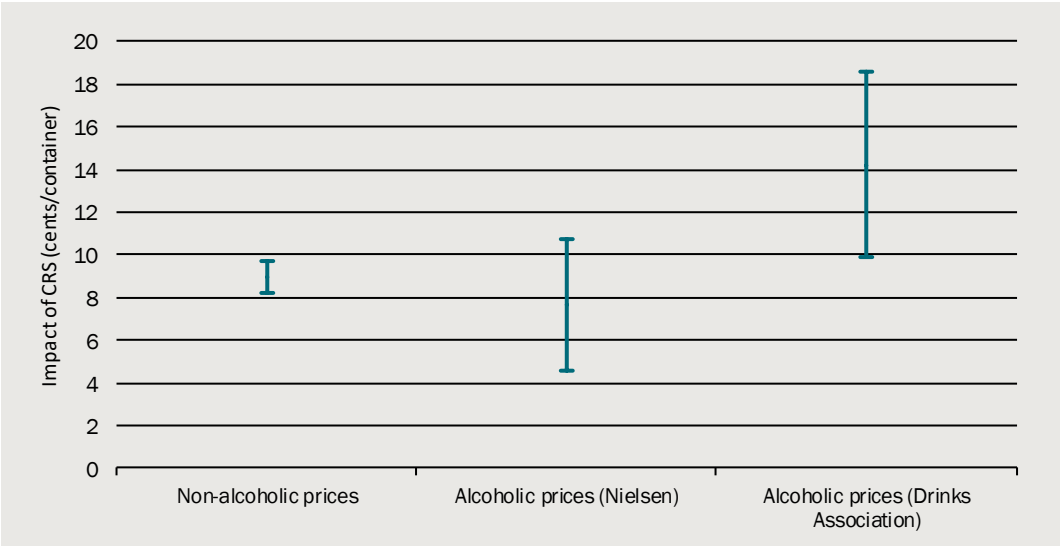
The same model sensitivities are run for the price impacts, with the exception of the specification using the logarithm, as this makes less sense for estimating price impacts. Therefore, the complete set of models tested include:

- Model 1 includes time and product-retailer-state fixed effects, and is estimated using data from Queensland and NSW
- Model 2 is the main model used in the report. It uses the same specification as model one, but includes data from all Australian states and territories
- Model 3 uses data from Queensland and NSW, but uses a state specific seasonal trend to account for potential variation in seasonality across states
- Model 4 uses data from all states and territories, and state specific seasonal trends
- Model 5 includes time and product-retailer-state fixed effects, and is estimated using data from Queensland and Victoria
- Model 6 uses a state specific seasonal trend and uses data from Queensland and Victoria.

These models were estimated using the Nielsen Homescan panel as well as the Drinks Association ad-watch database (for alcoholic beverages)

As can be seen, the price impacts for non-alcoholic beverages are robust, with a range of about 1-2 cents between the highest and lowest impact (chartA.4). Alcoholic price impacts are more variable, with the lowest estimate estimated at just over 4 cents per container, and the highest being over 18 cents per container. The alcoholic price impacts estimated from the Drinks Association dataset are similarly variable and are higher overall compared to the Nielsen estimates.

A.4 Sensitivity analysis to different specifications – price impacts



Data source: CIE calculations.

The full econometric output for non-alcoholic and alcoholic beverages using the Nielsen sample are presented in tables A.5 A.6, while the alcoholic results using the Drinks Association sample are presented in table A.7.

A.5 Sensitivity analysis – non-alcoholic beverages price impacts

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	cents/container	cents/container	cents/container	cents/container	cents/container	cents/container
CRS impact	9.34***	8.97***	8.45***	8.22***	9.68***	8.49***
Standard error	0.43	0.45	0.36	0.38	0.44	0.36
Percentage change	5.28	5.06	4.78	4.64	5.46	4.79
Constant	0.98	1.02	0.96	1.02	0.97	0.95
Product-retailer-state fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Month	Month	State-specific	State-specific	Month	State-specific
Comparison groups	QLD/NSW	QLD/Aus	QLD/NSW	QLD/Aus	QLD/Vic	QLD/Vic
F-statistic	84.32	60.72	175.97	153.24	39.56	133.24
F-test p-value	~0	~0	~0	~0	~0	~0
N [a]	157 093 552	165 933 728	157 093 552	165 933 728	151 687 776	151 687 776

[a] *Sample size N does not reflect dataset sample, as frequency weights were applied to each product in every period*

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.

Source: The CIE

A.6 Sensitivity analysis – alcoholic beverages price impacts (Nielsen sample)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	cents/container	cents/container	cents/container	cents/container	cents/container	cents/container
CRS impact	4.70***	4.58***	10.58***	10.49***	5.25***	10.79***
Standard error	1.37	1.54	1.46	1.48	1.61	1.41
Percentage change	1.56	1.52	3.51	3.48	1.74	3.58
Constant	1.64	1.70	1.67	1.76	1.54	1.57
Product-retailer-state fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Month	Month	State-specific	State-specific	Month	State-specific
Comparison groups	QLD/NSW	QLD/Aus	QLD/NSW	QLD/Aus	QLD/Vic	QLD/Vic
F-statistic	18.55	18.99	27.90	23.34	9.84	15.34
F-test p-value	~0	~0	~0	~0	~0	~0
N [a]	20 971 076	27 378 580	20 971 076	27 378 580	15 975 399	15 975 399

[a] *Sample size N does not reflect dataset sample, as frequency weights were applied to each product in every period*

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.

Source: The CIE

A.7 Sensitivity analysis – alcoholic beverages price impacts (Drinks Association sample)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Cents/container	Cents/container	Cents/container	Cents/container	Cents/container	Cents/container
CRS impact	10.44***	9.86***	18.58***	18.58***	10.09***	18.58***
Standard error	1.07	0.76	0.62	0.62	1.35	0.62
Percentage change	3.46	3.27	6.16	6.16	3.35	6.16
Constant	2.50	2.49	2.49	2.53	2.41	2.39
Product-retailer-state fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Month	Month	State-specific	State-specific	Month	State-specific
Comparison groups	QLD/NSW	QLD/Aus	QLD/NSW	QLD/Aus	QLD/Vic	QLD/Vic
F-statistic	49.86	59.00	94.03	94.04	30.63	80.35
F-test p-value	~0	~0	~0	~0	~0	~0
N	95 841	189 171	95 841	189 171	67 102	67 102

Note: *** for 1% significance, ** for 5% significance and * for 10% significance.

Source: The CIE

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