NHS Health Scotland

Monitoring and Evaluating Scotland's Alcohol Strategy

The impact of the Alcohol Act on off-trade alcohol sales in Scotland

May 2013

We are happy to consider requests for other languages or formats. Please contact 0131 536 5500 or email nhs.healthscotland-alternativeformats@nhs.net

Published by NHS Health Scotland

Edinburgh Office
Woodburn House
Canaan Lane
Edinburgh EH10 4SG

NHS Health Scotland is a WHO Collaborating Centre for Health Promotion and Public Health Development.

Authors

Mark Robinson, Public Health Information Manager, Public Health Observatory, NHS Health Scotland.
Dr Claudia Geue, Research Fellow, Health Economics and Health Technology Assessment, Institute of Health and Wellbeing, University of Glasgow.
Dr James Lewsey, Senior Lecturer (Medical Statistics), Economics and Health Technology Assessment, Institute of Health and Wellbeing, University of Glasgow.
Dr Daniel Mackay, Senior Lecturer (Public Health), Institute of Health and Wellbeing, University of Glasgow.
Dr Gerry McCartney, Consultant in Public Health and Head of Public Health Observatory, NHS Health Scotland.
Dr Esther Curnock, Clinical Research Fellow, MRC/CSO Social and Public Health Sciences Unit.
Clare Beeston, Principal Public Health Advisor, Evaluation Team, NHS Health Scotland.

This report should be cited as: Robinson M, Geue C, Lewsey J, Mackay D, McCartney G, Curnock E, Beeston C. Monitoring and Evaluating Scotland's Alcohol Strategy: The impact of the Alcohol Act on off-trade alcohol sales in Scotland. Edinburgh: NHS Health Scotland; 2013.

For further information about this publication please contact:
Mark Robinson, Public Health Information Manager, Public Health Observatory, NHS Health Scotland, markrobinson1@nhs.net

Acknowledgements

We would like to express our thanks to:

- Dr Dionne Mackison (NHS Health Scotland) who was a member of the study project team and provided useful comments on earlier drafts of the report.
- Professor Tim Stockwell (Centre of Addictions Research of British Columbia, University of Victoria) who provided peer-review.
- Helen Stares (The Nielsen Company) for providing expert advice on various aspects related to the off-trade alcohol sales data and for useful insights into promotional practices among off-trade retailers.
- Daniel Hill-McManus (School of Health and Related Research, University of Sheffield) for providing advice on interpreting results from the Scottish adaptation of the Sheffield Alcohol Policy Model.
- Andrew Leicester (Institute for Fiscal Studies) for providing information on household alcohol purchases on multi-buy promotions.
- Andrew Mortimer, Marjorie Marshall (both Scottish Government) and Neil Price (Office for National Statistics) for advising on the use of household expenditure and disposable income data.
- Rachael McNelis (NHS Health Scotland) for providing support with quality assurance.

Table of contents

Summary

Introduction

The Alcohol etc. (Scotland) Act 2010 (hereafter 'the Alcohol Act' or 'the Act') was implemented in Scotland on 1st October 2011. The Act included a ban on quantity based discounts and restrictions on the display and promotion of alcohol in Scotland's off-trade. Using time-series analyses of data for a 52-week period post-implementation and a comparison with England & Wales, this report assesses whether there were any changes in off-trade alcohol sales in Scotland after the introduction of the Alcohol Act.

Methods

Time-series analysis was used to test for any change in the volume of pure alcohol sold off-trade per adult (aged ≥16 years) after the introduction of the Alcohol Act in Scotland. Separate analyses were performed for all alcohol and by drink type. In secondary analyses, the impact of the Alcohol Act on the proportion of alcohol sold on promotion was also assessed. To provide a concurrent control group, the same analyses were performed using data for England & Wales where the Alcohol Act does not apply. Analyses accounted for seasonal and secular trends and were adjusted for disposable income, alcohol prices, on-trade alcohol sales and sales/promotions of other drink types.

Results

Alcohol sales

The Alcohol Act was associated with a 2.6% decrease in per adult off-trade alcohol sales in Scotland (95% CI -5.3 to 0.2%; P=0.07). This decline was driven by changes in off-trade wine sales, which decreased by 4.0% after the Act was introduced (95% CI -5.4 to -2.6; P<0.001). The Act was also associated with reduced sales of pre-mixed alcohol beverages (ready-to drink beverages (RTDs); -8.5%; 95% CI -12.7 to -4.1%; P<0.001), although these account for a very small proportion of the off-trade market. There was little evidence to suggest that the introduction of the Act was associated with any changes in off-trade beer (-1.1%; 95% CI -3.7 to 1.5%; P=0.40), spirits (-0.2%; 95% CI -2.7 to 2.3%; P=0.87) or cider/perry (-0.4%; 95% CI -4.5 to 3.9%; P=0.86) sales in Scotland. Although the Alcohol Act does not apply in England & Wales, it was included in analyses to enable comparison with Scotland. There were no statistically significant associations between off-trade sales and the 'dummy' Alcohol Act variable in England & Wales.

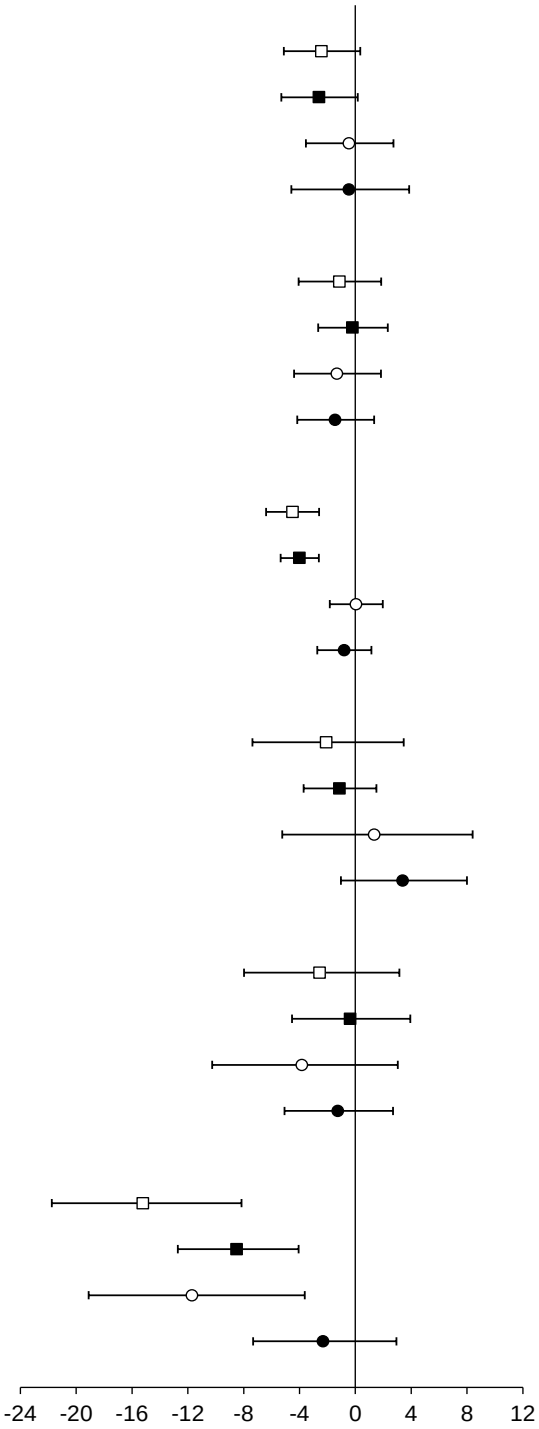
Alcohol sold on promotion

Data on off-trade alcohol promotions were limited and it was not possible to assess the impact of the Alcohol Act on specific promotional types. Using a very broad definition of promotional sales, which includes promotions that were restricted by the Act and promotions that were not, the Act was associated with a decrease in the proportion of total off-trade alcohol sold on promotion in Scotland (-11.3%; 95%CI -19.5 to -2.3%; P=0.02). In England & Wales, where the Act was not implemented, there was also a decrease in the proportion of off-trade alcohol sold on promotion over the same time period (-10.4%; 95%CI -17.2 to -2.9%; P=0.007).

Conclusion

In conclusion, the results from this study suggest that the introduction of the Alcohol Act reduced off-trade alcohol sales in Scotland, largely driven by a statistically significant decrease in off-trade wine sales. The Act was also associated with reduced RTD sales, although these account for a very small proportion of total off-trade sales. Similar changes were not observed in England & Wales, where the Act does not apply, which lends weight to the hypothesis that the changes witnessed in Scotland were as a result of the Act rather than due to other unmeasured factors.

Summary Figure: Estimates of percentage change in off-trade alcohol sales per adult after the introduction of the Alcohol Act in Scotland on 1st October 2011.



Percentage change in off-trade alcohol sales associated with the introduction of the Alcohol Act in Scotland

	%	95% CI			P-value
All alcohol					
Scotland	-2.4	-5.1	to	0.4	0.09
Scotland (adj)	-2.6	-5.3	to	0.2	0.07
England & Wales	-0.5	-3.6	to	2.7	0.78
England & Wales (adj)	-0.5	-4.6	to	3.9	0.83
Spirits					
Scotland	-1.2	-4.1	to	-1.9	0.45
Scotland (adj)	-0.2	-2.7	to	2.3	0.87
England & Wales	-1.3	-4.4	to	1.8	0.41
England & Wales (adj)	-1.5	-4.2	to	1.3	0.30
Wine					
Scotland	-4.5	-6.4	to	-2.6	<0.001
Scotland (adj)	-4.0	-5.4	to	-2.6	<0.001
England & Wales	0.1	-1.8	to	2.0	0.96
England & Wales (adj)	-0.8	-2.7	to	1.2	0.42
Beer					
Scotland	-2.1	-7.4	to	3.5	0.45
Scotland (adj)	-1.1	-3.7	to	1.5	0.40
England & Wales	1.4	-5.2	to	8.4	0.70
England & Wales (adj)	3.4	-1.0	to	8.0	0.14
Cider/perry					
Scotland	-2.6	-8.0	to	3.2	0.37
Scotland (adj)	-0.4	-4.5	to	3.9	0.86
England & Wales	-3.8	-10.3	to	3.0	0.27
England & Wales (adj)	-1.3	-5.1	to	2.7	0.53
RTDs					
Scotland	-15.2	-21.7	to	-8.2	<0.001
Scotland (adj)	-8.5	-12.7	to	-4.1	<0.001
England & Wales	-11.7	-19.1	to	-3.6	0.005
England & Wales (adj)	-2.3	-7.3	to	3.0	0.38

Notes: Off-trade sales data exclude discount retailers. All analyses account for underlying secular and seasonal trends. Adjusted (adj) models include adjustment for changes in disposable income, alcohol prices (mean sales price), on-trade alcohol sales and, for models where the outcome variable was a particular drink type, per adult off-trade sales of all other drink types combined.

Introduction

The Scottish Government has put in place a Framework for Action intended to rebalance Scotland's relationship with alcohol.[1] This builds on the Licensing (Scotland) Act (2005)[2] and is supplemented by the Alcohol etc. (Scotland) Act 2010[3] (hereafter 'the Alcohol Act' or 'the Act') and the Alcohol (Minimum pricing) (Scotland) Act 2012.[4] Collectively, these form Scotland's alcohol strategy. NHS Health Scotland has been tasked by the Scottish Government to lead the monitoring and evaluation of Scotland's alcohol strategy to determine its success or otherwise. This is being delivered by the Monitoring and Evaluating Scotland's Alcohol Strategy (MESAS) workstream, drawing on a portfolio of evaluation studies.[5]

The Alcohol Act was implemented on 1st October 2011[i] and introduced a number of new regulations concerning the sale of alcohol in Scotland. These included restricting the display and promotion of alcohol in the off-trade to within a single area of the store and a ban on off-trade quantity based discounts[ii]:

> *'A package containing two or more alcoholic products (whether of the same or different kinds) may only be sold on the premises at a price equal to or greater than the sum of the prices at which each alcoholic product is for sale.'*[3]

This part of the Act, often referred to as the 'ban on quantity discounts' or 'multi-buy discount ban', prohibits supermarkets and other off-trade retailers from providing discounts on multi-buy purchases. It is hypothesised that such discounts may encourage consumers to purchase more alcohol than they may otherwise have bought. Straight discounting of products from the list price remains permissible. Table 1 provides examples of promotions affected and those not affected by the introduction of the Alcohol Act in Scotland.

A preliminary descriptive analysis of the impact of the Alcohol Act was published in June 2012.[6] Across a 33-week post-ban period (October 2011 to May 2012), there was a decline in the volume of pure alcohol sold off-trade in Scotland from the corresponding period the year before. However, there was also a decline in England & Wales where the legislation did not apply. It was concluded that more advanced statistical analysis of data across a longer period post-implementation was required to ascertain the independent impact of the Alcohol Act.

Using time-series analyses of alcohol retail sales data for a 52-week period post-implementation, the main aim of this study was to provide a more robust assessment of the impact of the Alcohol Act on off-trade alcohol sales in Scotland. An additional aim was to examine the impact of the Alcohol Act on off-trade alcohol promotions.

The main evaluation question was:

- What impact has the introduction of the Alcohol Act had on off-trade alcohol sales in Scotland?

---

[i] The provision of the Act that chief constables report to Licensing Boards and Local Licensing Forums at the end of each financial year came into force on 1st April 2012.

[ii] The Act included a number of other provisions, such as the requirement of an age verification policy and a social responsibility levy, but the restrictions on display and promotions were considered most likely to impact on off-trade alcohol sales.

In addition, there were several sub-questions:

- To what extent did any impact differ by drink type?
- To what extent did any changes in off-trade alcohol sales differ from England & Wales, where the Act does not apply?
- What impact has the introduction of the Alcohol Act had on off-trade alcohol promotions in Scotland?

Table 1: Off-trade alcohol promotions affected and not affected by the Alcohol Act in Scotland.

Promotions prohibited by the Act	**Promotions allowed under the Act**
Any promotion where the price of a single product in a multi-pack or multi-buy offer is sold for less than the price of buying that same product on its own.	Promotions that are not linked to the purchase of multiple items, or which are linked to the volume rather than the number of products.
Examples:	**Examples:**
Two for the price of one; three for the price of two; buy one get one free; buy six get 20% off.	Straight discounting from list price e.g. half price offers; 'a third off' offers; £x off any individual item.
24 cans of lager costing less than 24 times the cost of one can of lager.	Cutting the price of a single can of lager so that it is as cheap as the cans sold in a multipack.
Three bottles of wine for £10 where each bottle costs more than £3.33.	Three bottles of wine for £10 as long as each bottle of wine is sold individually at £3.33.
A case of six bottles of wine sold cheaper than the total cost of six individual bottles if they are also available in the same store.	A case of wine priced at any level if the items are not available to buy individually.
	Different multipack prices or multi-buy multipack offers. For example, a 12-can pack of cider being sold for less than three times the cost of a 4-can pack of cider.
	The same product being sold in different sized containers. For example, a 70cl bottle of spirits being sold for less than twice the cost of a 35cl bottle.

Notes: Adapted from the Home Office.[7]

Methods

General approach

Multivariate time series analyses were performed to assess the independent impact of the implementation of the Alcohol Act on off-trade alcohol sales and promotions in Scotland.

Outcome variables

Off-trade alcohol sales data
NHS Health Scotland obtained estimates of off-trade alcohol sales in Scotland and England & Wales from The Nielsen Company ('Nielsen') for individual weeks between January 2009 and September 2012 (w/e 10/01/09 to w/e 29/09/12). Data were not available for a longer time period. Off-trade sales estimates were produced from electronic sales records from most large retailers (accounting for approximately three quarters of total off-trade sales) and a weighted stratified random sample of smaller retailers.

Alcohol volume sales (natural volumes) were categorised into drink type (spirits; wine; beer; cider/perry; ready to drink beverages (RTDs)[iii]; fortified wine (including Buckfast); and 'other') and converted into pure alcohol volumes (litres of pure alcohol) using a category-specific percentage alcohol by volume (ABV). The ABV used was based on the typical strength of drinks sold in that category and was provided by the data suppliers. Throughout this report, fortified wine (including Buckfast) and 'other' are categorised into a single 'other' category. Per adult alcohol sales were calculated by dividing pure alcohol volumes by the mid-year population aged ≥16 years, thus taking account of changes in population size over the study period.

From September 2011, Nielsen was no longer able to estimate off-trade sales by discount retailers Aldi and Lidl. As such, all alcohol sales data analysed for this report exclude these discount retailers. A detailed description of the methods used by Nielsen to collect off-trade data is provided elsewhere.[8]

Alcohol sold on promotion
Weekly data on the proportion of alcohol sold on promotion were provided by Nielsen for the period October 2009 to September 2012 (w/e 10/10/09 to w/e 29/09/12). Data were available for large, multiple grocers only. The definition used by Nielsen incorporates a wider range of discounting types than was prohibited under the Scottish legislation. A promotion was defined by Nielsen as any one of the following:

Feature: A product-specific feature that communicates a price discount benefit.
Display: A product promoted by making it available in a temporary location; for example, at the front of store or end of aisle.
Multi-buy: Reduced price based on the purchase of multiple products; store-card loyalty points based on the purchase of multiple products;
Price-cut: Regular selling price is discounted by 5% or more for less than six weeks.

Products may have more than one type of promotion at any one time as price promotions (multi-buy or price-cut) will typically be communicated to consumers in-store by feature or

[iii] RTDs are pre-mixed alcohol beverages typically based on spirits with a flavoured mixer to create a 'long' drink (e.g. Barcardi Breezer, Smirnoff Ice).

display activity. It was not possible to obtain data for individual types of promotion. Promotions were calculated by dividing the volume of alcohol sold on promotion (L) by the total volume of alcohol sold (L).

Covariates

There is strong evidence that alcohol consumption is linked to its affordability.[9] To control for the potentially confounding effects of affordability (the relationship between disposable income and alcohol price) during the time period analysed, measures of income and price were included in the analysis.

Income data
Quarterly data on gross disposable household income were obtained for Scotland[10] and for the UK.[11] In brief, these data measure the amount of money that individuals have available for spending or saving. This is money remaining after expenditure associated with income, such as taxes, property ownership,and social and pension contributions are deducted. Numerous sources, comprising both survey and administrative data, are used to compile disposable income data, conforming as far as possible to international guidance.[12] As data for England & Wales were not available separately, a proxy measure was created by subtracting gross disposable income in Scotland from gross disposable income in the UK. Income data were expressed per adult aged ≥16 years.

Alcohol price data
Two measures of alcohol price were considered for inclusion as a covariate in the time-series models: mean sales price and alcohol price index.

Mean sales price: Weekly estimates of the mean sales price of alcohol sold off-trade in Scotland and England & Wales were calculated (for all alcohol and by drink type) using Nielsen data by dividing retail sales value (£) by the volume of pure alcohol sold. It is important to note that trends in the mean sales price of alcohol do not directly reflect trends in alcohol prices charged. This is because changes in mean sales prices are the product of both changes in prices charged and changes in patterns of consumption. Nonetheless, mean sales price has been used in previous studies[13,14] and has been shown to be a good proxy for prices charged.[5]

Alcohol price index: The alcohol price index is an alcohol-specific measure of the retail price index. It provides a measure of changes in alcohol prices charged over time. Alcohol price index data are available at UK level for either all alcohol or separately by trade sector for beer and wine/spirits (combined). The index for all alcohol was used because it enabled only a single variable to be entered into analytical models and because changes over the study period were similar across indexes. Monthly data were obtained from the Office for National Statistics.[15]

On-trade alcohol sales data
Off-trade alcohol is cross price elastic.[16] This means that consumers may switch between alcohol products (e.g. from spirits to wine) and alcohol sources (e.g. from off-trade to on-trade) in response to changes in price. Therefore, to control for these potential effects in the present analyses, models were also adjusted for sales of other drink types and on-trade alcohol sales (L per adult).

The data source for on-trade alcohol sales are described in detail elsewhere.[8] Briefly, data on the volume of alcohol sold through the on-trade in Scotland and England & Wales were obtained from CGA Strategy. CGA use a stratified sampling frame to obtain data from deliveries, electronic sales records and surveys to provide representative sales figures which

are subsequently weighted to provide an overall estimate of on-trade alcohol sales. Natural volumes were converted to pure alcohol volumes using the same process as described for off-trade sales data. On-trade data were available by drink type for 4-weekly periods (i.e. 13 period calendar) from January 2009 to September 2012 (w/e 24/01/2009 to w/e 06/10/2012); weekly on-trade sales estimates were derived using linear interpolation.

Population data

Mid-year population estimates for Scotland were obtained from National Records of Scotland (NRS)[17] and for the rest of the UK from the ONS.[18] Population estimates were subsequently interpolated for each of the different time divisions of the variables included in analyses (i.e. weekly, monthly and quarterly), assuming a linear trend between each mid-year estimate.

Analysis

Descriptive analysis

All data were initially analysed descriptively to enable trends and other key information to be presented in tables and figures.

Time-series analysis

Time-series analysis was used to test for any change in the volume of pure alcohol sold off-trade per adult after the introduction of the Alcohol Act in Scotland. Autoregressive Integrated Moving Average (ARIMA) models were used to enable changes to be assessed independent of secular and seasonal trends in off-trade alcohol sales. Separate analyses were performed for all alcohol and for each drink type (except 'other'). In secondary analyses, the same analytical approach was used to assess the impact of the Alcohol Act on the proportion of alcohol sold on promotion.

All time-series models were adjusted for changes in disposable income, alcohol prices (either mean sales price or alcohol price index), on-trade alcohol sales and, for models where the outcome variable was a particular drink type, off-trade sales (or promotions) of all other drink types combined. To provide a concurrent control group, the same analyses were performed using data for England & Wales where the Alcohol Act does not apply. A full description of the methods employed in the time-series analyses is provided in Appendix 1. Results from the time-series analyses are expressed as percentage changes in off-trade alcohol sales (or promotions) associated with the implementation of the Alcohol Act in Scotland on 1st October 2011.

Additional post-hoc analyses (using Ordinary Least Squares regression) were performed to test whether or not the estimated effect of the Alcohol Act on off-trade sales of all alcohol and wine were significantly different in Scotland compared with England & Wales.

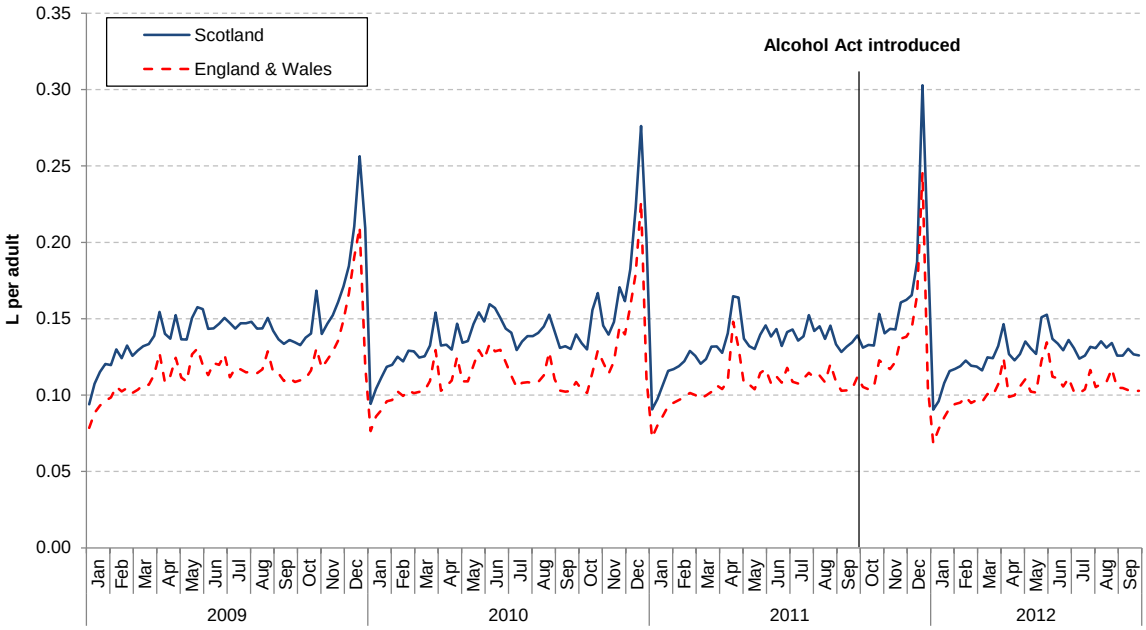
Results

Descriptive analysis

Off-trade alcohol sales

Figure 1 shows the weekly volume of pure alcohol sold off-trade in Scotland and England & Wales between January 2009 and September 2012. Off-trade alcohol sales fell in both Scotland and England & Wales over the study time period. There is clear seasonality in off-trade alcohol sales. From January, alcohol sales generally increase into the summer. This is followed by a slight decrease in September and early October, before sales start steadily increasing again. A sharp increase in December reaches its peak in the final weeks of the calendar year, before a sharp decline in January. The seasonality of off-trade alcohol sales is very similar in both Scotland and England & Wales, and for all drink types (Figures A2.1-A2.5, Appendix 2). However, off-trade alcohol sales are consistently higher in Scotland than in England & Wales. In the 12-month period before the Act was introduced, 25% more alcohol was sold off-trade per adult in Scotland compared with England & Wales. The disparity is largely driven by higher spirits sales in Scotland, although annual sales of all drink types are higher in Scotland (Table 2).

Figure 1: Volume of pure alcohol sold off-trade per adult per week in Scotland and England & Wales, January 2009-October 2012.



Notes: Off-trade sales data exclude discount retailers.

Table 2: Off-trade alcohol sales in Scotland and England & Wales in the 12 month period before the Alcohol Act was introduced in Scotland, by drink type.

	Volume (L per adult)		Market share (%)	
	Scotland	England & Wales	Scotland	England & Wales
All alcohol	7.4	5.9	100	100
Spirits	2.5	1.4	33	24
Wine	2.4	2.2	33	26
Beer	1.7	1.6	23	38
Cider/perry	0.6	0.5	8	8
RTDs	0.1	0.0	1	1
Other*	0.2	0.2	3	3

Notes: Off-trade sales data exclude discount retailers. Columns may not add to 100% because of rounding. *Not included in time-series analyses.

Alcohol sold on promotion

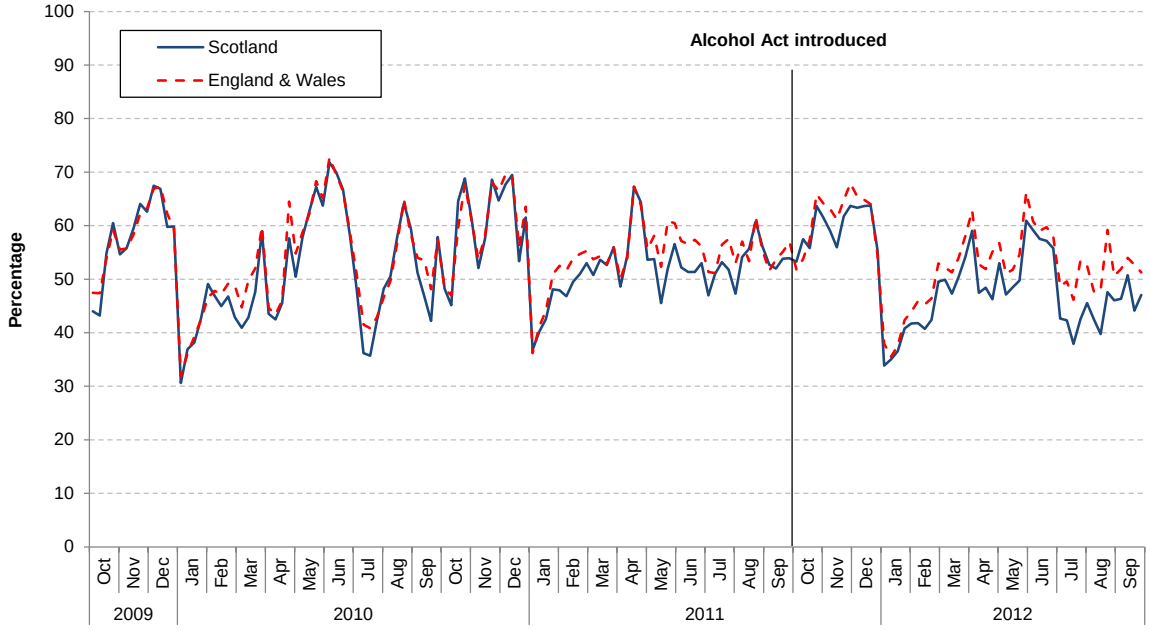
In the 12 month period before October 2011, the majority of beer, wine and RTDs sold off-trade in Scotland and England & Wales was sold on promotion, while for spirits it was approximately 45% (Table 3). Week-to-week fluctuations in the proportion of wine sold on promotion are smaller than other drink types (Figures A2.6-A2.10). Besides a sharp fall in promotional sales after the Christmas period, there is no obvious seasonality in off-trade promotional sales of all drink types combined (Figure 2).

Table 3: Mean proportion of alcohol natural volume sales sold on promotion in Scotland and England & Wales in the 12 month period before the Alcohol Act was introduced in Scotland, by drink type.

	% sold on promotion	
	Scotland	England & Wales
All alcohol	55	57
Spirits	45	44
Wine	54	55
Beer	61	63
Cider/perry	48	48
RTDs	56	50
Other*	25	28

Notes: Off-trade sales data exclude discount retailers. Data are based on alcohol sales in large multiple grocers only and do not distinguish between promotion type. *Not included in time-series analyses.

Figure 2: Proportion of alcohol sold on promotion in Scotland and England & Wales, October 2009-September 2012.

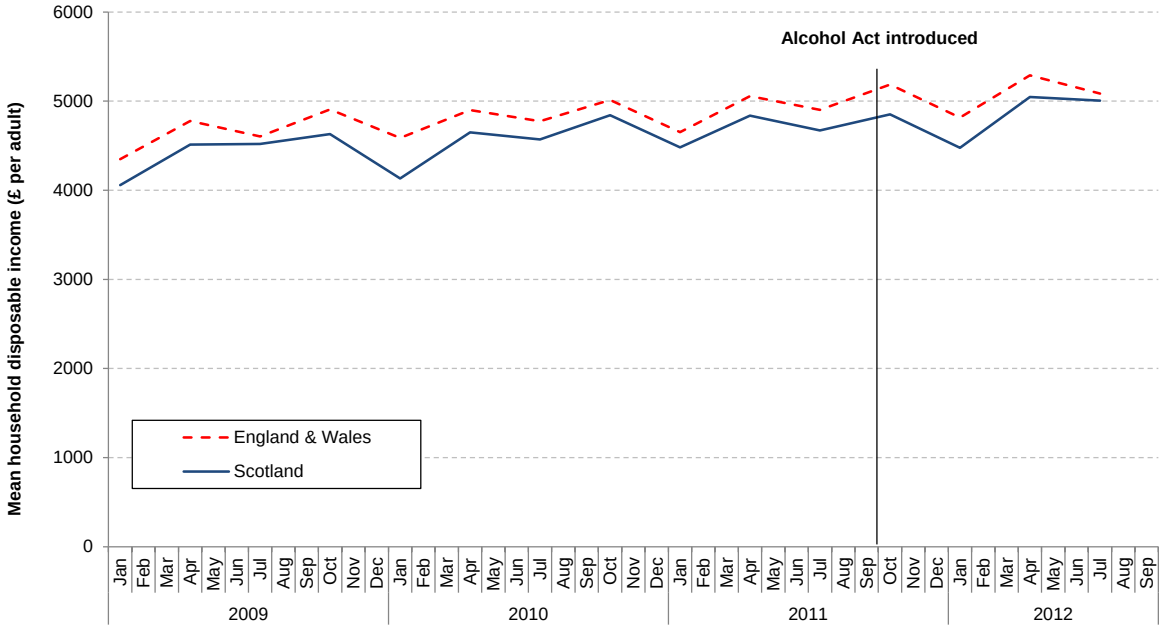


Notes: Off-trade sales data exclude discount retailers. Data are based on alcohol sales in large multiple grocers only and encompass all types of promotional activity.

Disposable income and alcohol prices

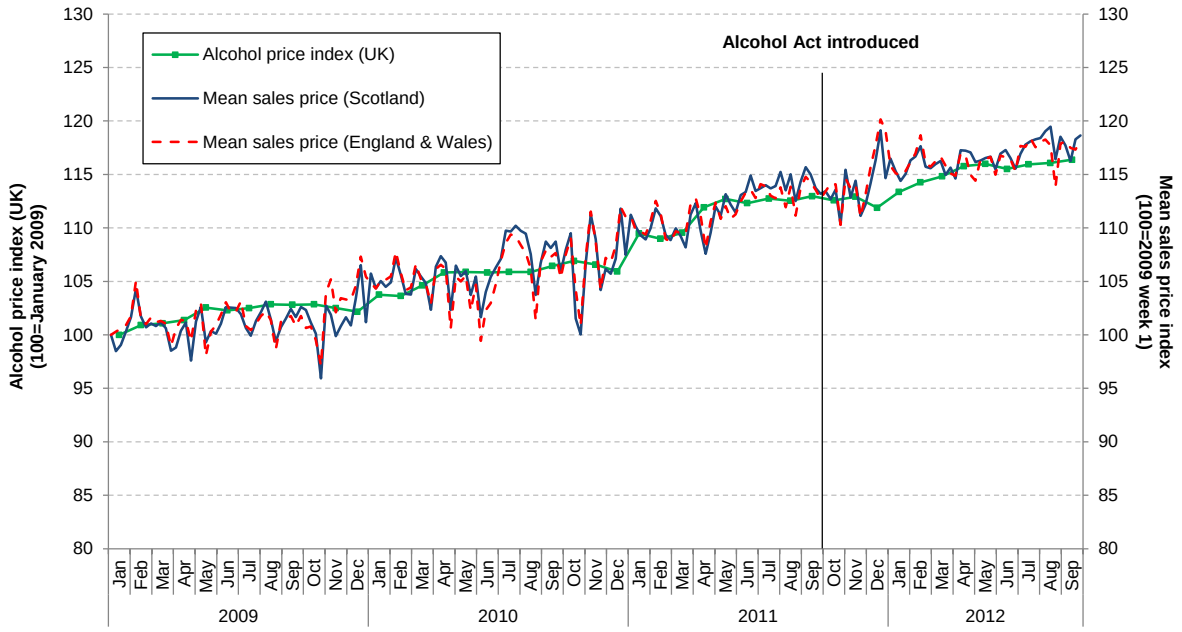
Quarterly data on gross disposable household income per adult (unadjusted for inflation) shows a fluctuating upward trend between January 2009 and July 2012 in both Scotland and England & Wales (Figure 3). Disposable income per adult generally follows a seasonal pattern, increasing over the 1st and 3rd quarters of the calendar year, but decreasing over the 2nd and 4th quarters. Over the study time period, disposable income increased by 23% in Scotland and by 17% in England & Wales.

Figure 3: Gross disposable household income per adult in Scotland and England & Wales, 2009 Q1 to 2012 Q3.



Between January 2009 and September 2012, the mean sales price of total off-trade alcohol sales increased by 19% in Scotland and 18% in England & Wales (Figure 4). The largest increase in mean sales price was for cider/perry (Scotland=26%; England & Wales=29%) and spirits (Scotland=26%; England & Wales=25%), followed by wine (Scotland=17%; England & Wales=18%) and beer (Scotland=8%; England & Wales=9%). Over the same time period, the alcohol price index for the UK increased by 16% (Figure 4).

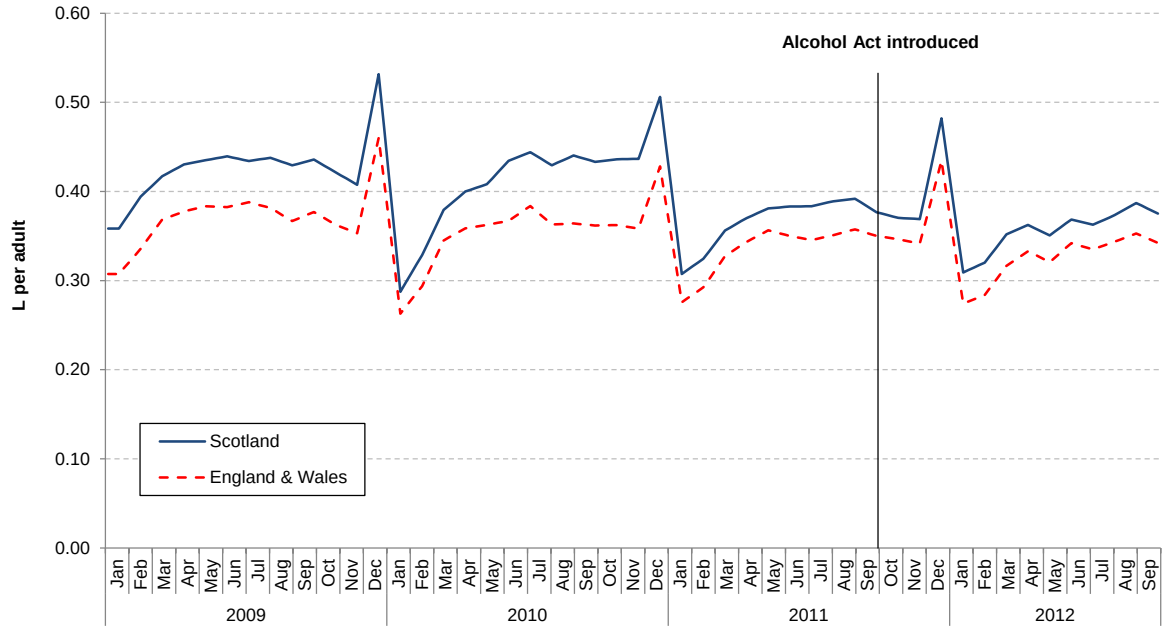
Figure 4: Mean sales price of all-off trade alcohol sold in Scotland and England & Wales, January 2009 to September 2012.



On-trade alcohol sales

On-trade alcohol sales in Scotland and England & Wales followed a similar seasonal pattern between January 2009 and September 2012 (Figure 5). On-trade sales generally increase from January into the summer months. This is followed by a stable or slightly downward trend through autumn. A sharp increase in December is then followed by a substantial decrease in January. Over the time period analysed, on-trade alcohol sales have been consistently higher in Scotland than in England & Wales, although the gap has narrowed. In 2009 and 2010, about 15% more pure alcohol was sold on-trade per adult in Scotland, while in 2011 and 2012 (January-September only) on-trade sales were about 10% higher.

Figure 5: Volume of pure alcohol sold on-trade per adult per week in Scotland and England & Wales, January 2009-October 2012.



Notes: Weekly on-trade sales data interpolated from 4-weekly data.

Time-series analysis

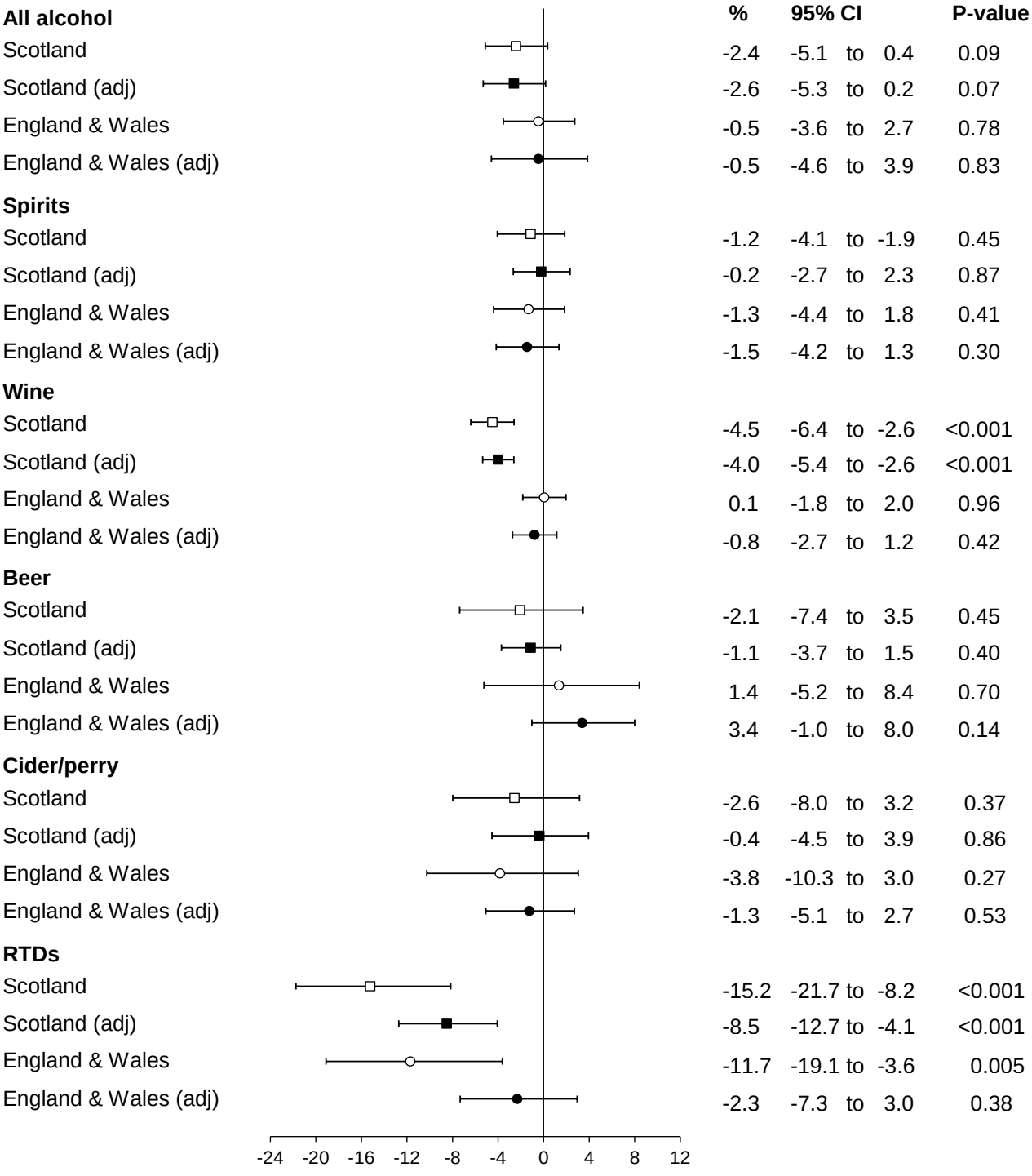
Results from the time-series analyses suggested that mean sales price was a more appropriate covariate for alcohol price because, unlike the alcohol price index, it was strongly associated with the outcome variable i.e. off-trade alcohol sales. Furthermore, mean off-trade sales prices were available weekly and separately for Scotland and England & Wales. In contrast, the alcohol price index is only routinely available monthly, for the off-trade sector by drink type, and as a composite measure for the UK. Thus, results described in the main report are based on analyses that included adjustment for disposable income and mean sales price. Results from unadjusted analyses are also presented in figures. Results from analyses that included adjustment for the alcohol price index are shown in Appendix 1.

Alcohol sales

Results from the adjusted time-series analyses show that the introduction of the Alcohol Act was associated with a 2.6% decrease in per adult off-trade alcohol sales in Scotland (95% CI -5.3 to 0.2%; P=0.07; Figure 6). This decline was driven by changes in off-trade wine sales, which decreased by 4.0% after the Act was introduced (95% CI -5.4 to -2.6; P<0.001). The Act was also associated with reduced RTD sales (-8.5%; 95% CI -12.7 to -4.1; P<0.001), although these make up a very small proportion of the off-trade market (Table 1). There was little evidence to suggest that the introduction of the Act was associated with any changes in off-trade beer (-1.1%; 95% CI -3.7 to 1.5%; P=0.40), spirits (-0.2%; 95% CI -2.7 to 2.3%; P=0.87) or cider/perry (-0.4%; 95% CI -4.5 to 3.9%; P=0.86) sales in Scotland. Although the Alcohol Act does not apply in England & Wales, it was entered as a covariate in analyses to enable comparison with Scotland. There were no statistically significant associations between off-trade sales and the dummy Alcohol Act variable in England & Wales.

The regression analyses to test whether the effects of the Alcohol Act differed in Scotland compared with England & Wales showed that for both all alcohol (P=0.01) and wine (P=0.002), the estimated effects were significantly different.

Figure 6: Estimates of percentage change in off-trade alcohol sales per adult after the introduction of the Alcohol Act in Scotland on 1st October 2011.



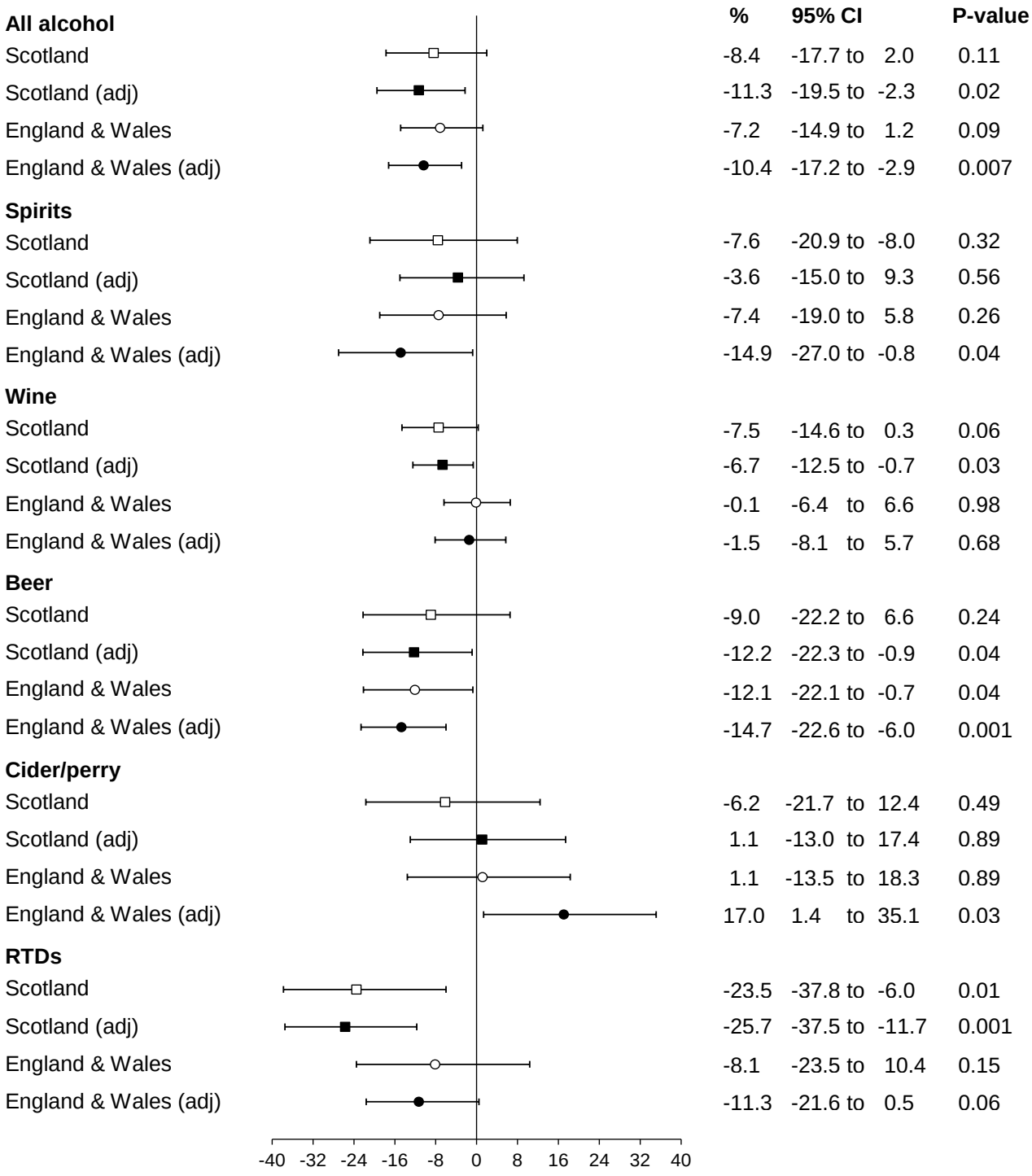
Notes: Off-trade sales data exclude discount retailers. All analyses account for underlying secular and seasonal trends. Adjusted (adj) models include adjustment for changes in disposable income, alcohol prices (mean sales price), on-trade alcohol sales and, for models where the outcome variable was a particular drink type, per adult off-trade sales of all other drink types combined. Results for models that adjusted for the alcohol price index instead of mean sales price are shown in Appendix 1.

Alcohol sold on promotion

The Alcohol Act was associated with a statistically significant decrease in the proportion of total off-trade alcohol sold on promotion in Scotland (-11.3%; 95% CI -19.5 to -2.3%; P=0.02; Figure 7). This can be attributed to negative associations between the introduction of the Act and the proportion of beer (-12.2%; 95% CI -22.3 to -0.9%; P=0.04), wine (-6.7%; 95% CI -12.5 to -0.7%; P=0.03) and RTDs (-25.7%; 95% CI -37.5 to -11.7%; P=0.001) sold on promotion.

In England & Wales, where the Act was not implemented, there were also significant changes in the proportion of off-trade alcohol sold on promotion over the same time period. For example, there was evidence of decreases in the proportion of beer (-14.7%; 95% CI -22.6 to -6.0%; P=0.001), spirits (-14.9%; 95% CI -27.0 to -0.8%; P=0.04) and RTDs (-11.3%; 95% CI -21.6 to 0.5%; P=0.06) sold on promotion which, in turn, led to an impact on total off-trade promotional sales (-10.4%; 95% CI -17.2 to -2.9%; P=0.007). In contrast, there was a positive association between the timing of the Act being introduced in Scotland and the increase in the proportion of cider sold on promotion in England & Wales (17.0%; 95% CI 1.4 to 35.1%; P=0.03), while there was no evidence of an association with wine promotions (-1.5%; 95% CI -8.1 to 5.7; P=0.68).

Figure 7: Estimates of percentage change in the proportion of off-trade alcohol sold on promotion after the introduction of the Alcohol Act in Scotland on 1st October 2011.



Notes: Off-trade sales data exclude discount retailers. All analyses account for underlying secular and seasonal trends. Adjusted (adj) models include adjustment for changes in disposable income, alcohol prices (mean sales price), on-trade alcohol sales and, for models where the outcome variable was a particular drink type, the proportion of all other drink types sold on promotion (combined). Results for models that adjusted for the alcohol price index instead of mean sales price are shown in Appendix 1.

Discussion

The introduction of the Alcohol Act in Scotland on 1st October 2011 was associated with statistically significant decreases of 4.0% in off-trade wine sales and 8.5% in off-trade RTD sales, and a statistically non-significant 2.6% decrease in total off-trade alcohol sales. These effects were independent of a number of potential confounders, including underlying seasonal and secular trends, alcohol affordability (disposable income and alcohol prices), on-trade alcohol sales and sales of other drink types. The Act did not appear to be associated with changes in off-trade beer, spirits or cider/perry sales in Scotland.

To assess the impact of the Alcohol Act on off-trade alcohol sales in Scotland, an 'Alcohol Act' variable was entered as an explanatory variable in the time series models. To provide a concurrent control, data for England & Wales were analysed using an identical approach. While the introduction of the Act was associated with decreases in off-trade sales of all alcohol, wine and RTD sales in Scotland, there was little evidence of similar decreases in England & Wales. This lends weight to the hypothesis that the changes witnessed in Scotland were as a result of the Act rather than due to other unmeasured factors.

One of the key policy measures included in the Alcohol Act was the ban on multi-buy promotions in the off-trade. This measure was intended to restrict price incentives that may encourage consumers to purchase more alcohol than they may otherwise have bought, thereby reducing consumption. The decline in off-trade wine sales in Scotland was supported by secondary analyses that showed that the prevalence of promotional wine sales in Scotland also significantly reduced after the Act's implementation, while there was no change in England & Wales. Indeed, Figure A2.7 in Appendix 2 visibly shows a change in trend in Scotland after the Act was implemented. An effect on brief spikes in wine promotions is particularly apparent as these were common before the Act and also remained in England & Wales in the post-Act implementation period.

These findings suggest that wine may have been the drink type most likely to be promoted using multi-buy offers. Consumers are more responsive to promotional discounting and, in general, are more responsive to multiple-item price promotions than a straight discount from the list price.[19] Unfortunately, because the available data encompassed all alcohol promotions, it was not possible to ascertain any differences in the nature of off-trade promotions either between drink types or between countries. An observational study in North East England suggested that, as a proportion of all multiple-item price discounts on offer, wine and beer were the most likely to be promoted on a multi-buy basis, while spirits (combined with RTDs and strong wine) were least likely.[20] Using consumer panel expenditure data, Griffith *et al* recently reported that sampled households bought a larger proportion of beer (23%) and RTDs (22%) on multi-buy offers, while the proportions for wine (16%) and, most markedly, spirits (4%) were lower.[21] The proportion of beer sold on promotion significantly decreased in association with the Act in Scotland, but this was also the case in England & Wales where there are currently no restrictions on off-trade promotions. Similarly RTD promotions decreased across Great Britain since the Act was introduced, albeit the size of the effect was larger and more certain in Scotland. The prevalence of spirits sold on promotion was not associated with the Act in Scotland, but the dummy Act variable was associated with decreased promotional sales of spirits in England & Wales.

It was also notable that the decreased prevalence of beer promotions associated with the Act in Scotland did not result in off-trade beer sales declining. Exploratory post-hoc analyses did show that promotions were significantly associated with off-trade sales for all alcohol and across drink types. They also revealed that the size of the association between off-trade sales and the Alcohol Act being introduced was slightly weakened when the proportion of

alcohol sold on promotion was included as a covariate. Nonetheless, the promotional sales data are too unspecific to enable robust and meaningful interpretations of the effect of the Act on the multi-buy promotions. If a multi-buy discount ban is implemented in other countries in the future, evaluators should seek to obtain more disaggregated promotional sales data.

There is currently no direct evidence to show the impact of multiple-item alcohol promotions on alcohol consumption in the off-trade. Using sophisticated econometric modelling, Meng and colleagues used market research data on the prevalence and magnitude of promotional sales to estimate alcohol price increases if off-trade sales promotions were restricted, and the impact that this might have on alcohol consumption and associated harms.[22] In Scotland, it was estimated that a total ban on off-trade discounting (including straight discounting) would decrease overall consumption by 3.0%, with the largest effect being estimated for wine (-5.4%). Despite differences in the policy intervention analysed, as well as the data source used to estimate consumption, this is consistent with the present results: the introduction of the Alcohol Act was associated with a significant 4.0% decline in off-trade wine sales in Scotland and a 2.6% decrease in total off-trade sales. However, the Sheffield model also estimated that beer sales would decrease by 1.9%, with only a negligible effect on RTDs (-0.9%). In this study, there was no evidence that the Act was independently associated with changes in off-trade beer sales, while there was a relatively large, but imprecise, association with off-trade sales of RTDs.

Retailers have responded to the multi-buy discount ban in Scotland by enhancing other promotions, such as price-cuts and in-store displays (The Nielsen Company, personal communication). Indeed, an average of 50% of all off-trade alcohol sales in Scotland in the 12-month period after the ban was introduced has been on promotion. Although it was possible that consumers could have either switched drink types or consumed more on-trade alcohol in response to the ban on quantity discounts, these possibilities were adjusted for in the analyses and therefore do not explain the findings. This suggests that the estimated impact of the Alcohol Act described in this report may have been larger if a total ban on off-trade discounting was introduced. However, a total ban on discounting would be likely to have faced significant legal challenges.

The Alcohol (Minimum Pricing) (Scotland) 2012 Act was enacted in Scotland in June 2012.[4] This allows the implementation of minimum unit pricing for all alcohol sold through licensed premises in Scotland. If implemented, minimum unit pricing would prevent retailers from straight discounting products to a price that is below its minimum price based on its alcohol content. The UK government has also consulted on the introduction of restrictions on multi-buy price promotions and minimum unit pricing. Results from this study will provide useful evidence for the UK Government to consider as their policy process progresses.

Strengths and limitations

There have been a number of reports assessing the impact of the quantity discount ban since it was introduced in Scotland in October 2011.[6,23,24] As these have all used descriptive analysis, results have varied, with an inability to provide definitive conclusions about the specific impact of the ban. The main strength of this study was its flexible and robust analytical approach, ARIMA modelling, which accounts for secular and seasonal trends in the data series. Models were also adjusted for a range of potential confounders, including indicators of disposable income and alcohol price (together a proxy for affordability). Crucially, it was possible to compare effects with England & Wales, the most appropriate geographical control that was not subject to the Alcohol Act legislation. This provides confidence that the estimated effects associated with the Alcohol Act are independent of the normal behaviour of the off-trade sales data and not related to other unmeasured confounding factors.

Alcohol retail sales data were used as an indicator of off-trade alcohol consumption. These data provide the most valid and reliable proxy for alcohol consumption.[8] The large majority of off-trade sales data are collected by store-census, including all the major supermarket chains, which are responsible for approximately 75% of all off-trade alcohol sales (The Nielsen Company, personal communication). In other words, every alcohol product that is scanned at the checkout is captured, thereby enabling a precise estimate of total off-trade sales. A further strength of the analyses is that pure alcohol volumes per adult have been used rather than natural volumes. This takes into account the strength of different beverage types, as well as differences in population sizes both over time and between areas. Indeed, using per adult alcohol sales to measure and monitor population levels of alcohol consumption is recommended by the World Health Organization.[25]

A number of limitations should also be noted. As discussed earlier, the available data on promotional alcohol sales were limited. It was not possible to distinguish between different types of promotion, thus making interpretations of the impact of the Act on promotions challenging, particularly in relation to the changes observed in sales.

The weekly off-trade alcohol sales data exclude discount retailers such as Aldi and Lidl. The market share of discount retailers in Great Britain was 9% in 2012, increasing from 3% in 2009.[26] Although data on the specific nature of price promotions within these discount retailers were not available, it is known that a lower proportion of alcohol is sold on promotion compared with other major retailers. This is because they tend to maintain low, everyday prices rather than promote special offers (The Nielsen Company, personal communication). Retail analysts suggest that straight price reductions may be more preferable to shoppers than quantity discounts when household budgets become tighter during economic recession.[24] Thus, if consumers in Scotland responded to the ban on multi-buy promotions by purchasing more alcohol from discounters, the results reported here may have slightly overestimated the magnitude of effects. Similarly, although supermarket online sales are captured where they are part of online grocery shopping (as these orders are packed and scanned at a local store), alcohol sales through certain internet and mail order retailers are not captured by the data providers.[8] It is therefore possible that the decline in off-trade sales of wine and RTDs in Scotland may have, at least in part, been offset by increases in online sales. Analysis of consumer panel expenditure data may provide important insights into any changes in alcohol sales among those retailers not included in the sample frame since the Act's introduction in Scotland.

Retail sales data do not enable disaggregation by different population subgroups. It was therefore not possible to assess the differential impact of the Alcohol Act on individuals with different alcohol consumption patterns, demographic characteristics and socioeconomic circumstances. Modelling suggests that heavy drinkers would be the most likely to be affected by measures that increase price, including a total ban on off-trade price promotions.[22] However, Griffith *et al* recently reported that the proportion of alcohol purchased on multi-buy discounts decreased as the total volume of alcohol bought by a household increased.[21] According to self-report surveys, the proportion of an individual's weekly alcohol consumption accounted for by wine – the only major drink category that reduced in association with the Act - increases with household income.[27] Nonetheless, exploring the specific impact of a multi-buy discount ban on individuals with different consumption patterns and sociodemographic characteristics was not possible in this study and remains unclear. Research that directly measures the impact of restrictions on price promotions by different population groups would provide further context to the findings presented in this report. However, such research will rely on self-report data, which are known to underestimate consumption derived from sales data[28] and are limited by various biases including response bias and selection bias, which reduce population representativeness.

Weekly data for the 52-week period after implementation provided enough data points to enable time-series modelling of the effect of the Alcohol Act. Nonetheless, more data points would be preferable. A seasonal time-series model meant that 52 data points (first 52 observations for the year 2009) were lost from the main analyses due to differences between weeks being taken. Similar analyses performed in future years will provide insight into the longevity of the estimated effects of the Alcohol Act, perhaps in the context of different economic conditions, and also help to improve the precision of the effect estimates.

Finally, the data used to adjust models for disposable income and alcohol price (mean sales price and alcohol price index) were the best available. However, they were limited in various ways. Income data were only available on a quarterly basis. Also, the data used for England & Wales to adjust models included Northern Ireland, but this had only a very marginal impact on the income estimates. Changes in the mean sales price of off-trade alcohol may not reflect changes in prices charged, but instead may be a consequence of shifts in consumer behaviour. The alcohol price index, which measures changes in the price of a fixed basket of alcohol products is only available on a monthly basis and as a composite measure for the UK. Models adjusting for mean sales price had a better fit in this study. However, despite some small differences in the magnitude of the estimated effects, it is reassuring that the results are generally consistent with those models that adjusted for the alcohol price index (Appendix 1).

Conclusion

In conclusion, the results from this study suggest that the introduction of the Alcohol Act reduced off-trade alcohol sales in Scotland, largely driven by a statistically significant decrease in off-trade wine sales. The Act was also associated with reduced RTD sales, although these account for a very small proportion of total off-trade sales. Similar changes were not observed in England & Wales, where the Act does not apply, which lends weight to the hypothesis that the changes witnessed in Scotland were as a result of the Act rather than due to other unmeasured factors.

Appendix 1: Further details on statistical methods

Time-series analysis

Weekly off-trade alcohol sales data are time-series data. Each observation in a time-series is somewhat dependent upon the previous observation, and is often influenced by more than one previous observation.[29] This is known as serial and seasonal autocorrelation, respectively. Such autocorrelation violates the assumption of independence in standard linear regression as it biases the standard errors of parameter estimates. Data were therefore analysed using Box-Jenkins Autoregressive Integrated Moving Average (ARIMA) models.[30] This method can address serial and seasonal trends in time-series data and so is particularly useful for assessing the independent impact of policy interventions.

All analyses were undertaken using Stata/SE12.1 software (STATA Corp, Texas).

Data preparation

A test for Normality of the distribution of weekly off-trade alcohol sales data in Scotland and England & Wales, using a Kernel Density plot, revealed that the data were not Normally distributed; both series of data were positively skewed (Figure A1.1a). The data were therefore transformed using the natural logarithm (Figure A1.1b).

Figure A1.1a: Kernel density plot of total volume of pure alcohol sold off-trade per adult per week in Scotland, January 2009-October 2012.

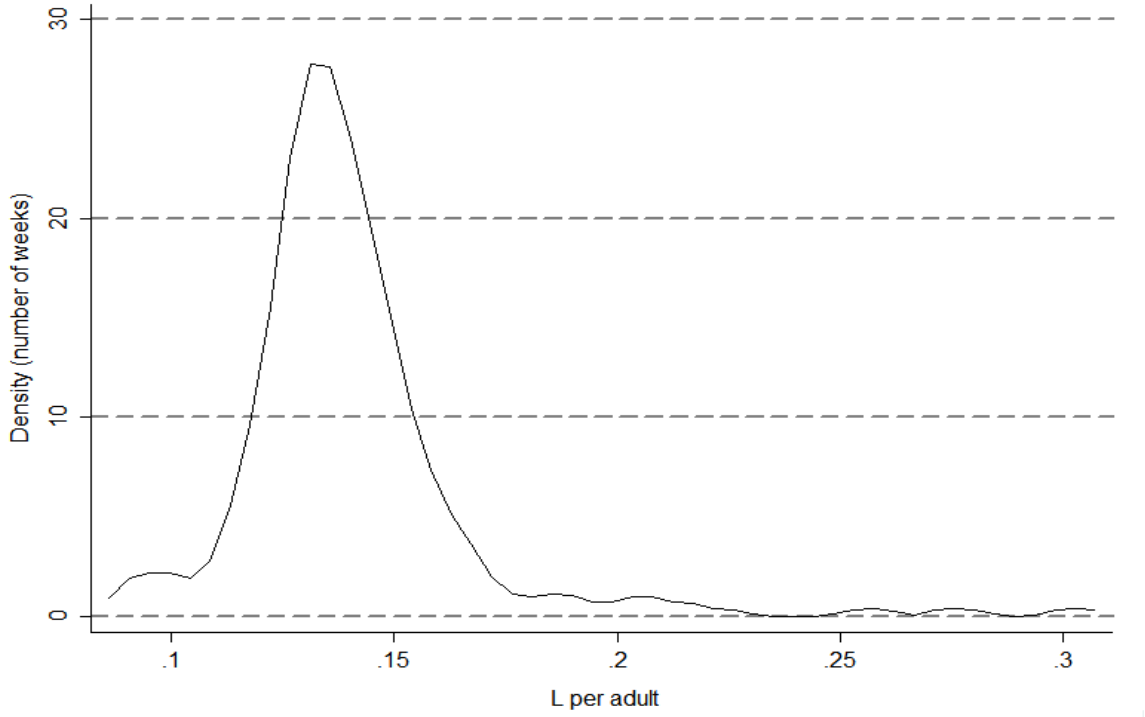
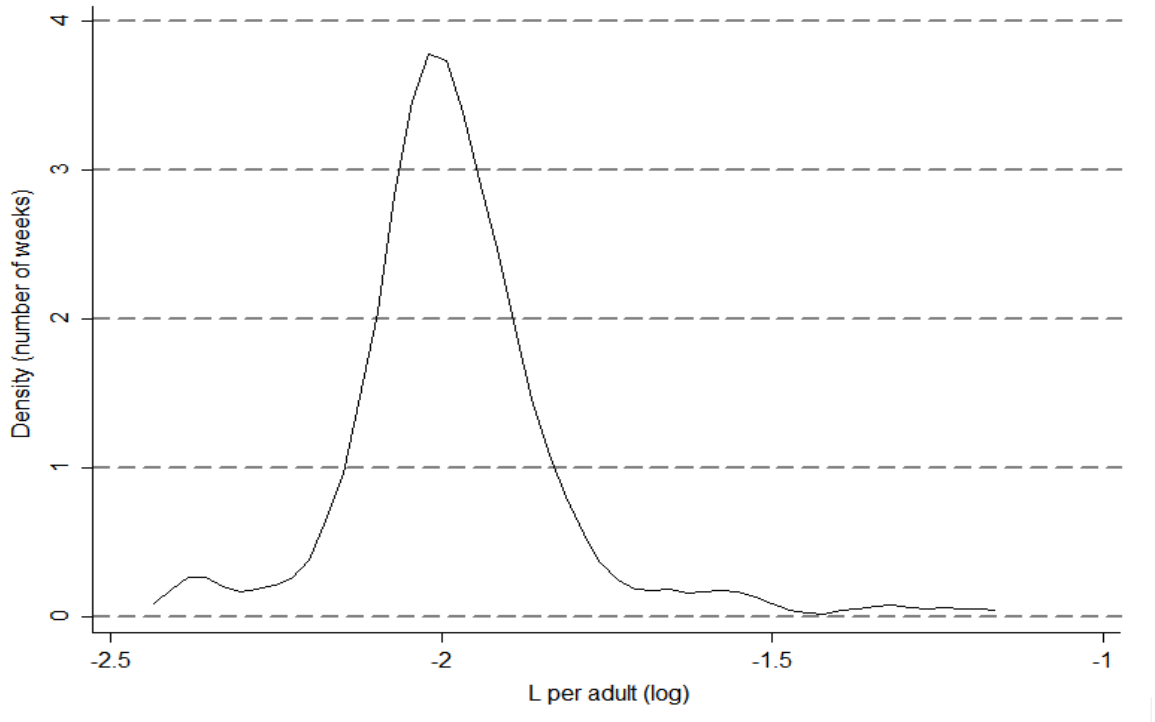


Figure A1.1b: Kernel density plot of total volume of pure alcohol sold off-trade per adult per week in Scotland after log transformation, January 2009-October 2012.



Diagnosis of autocorrelation

The correct specification of any serial and/or seasonal correlation in the alcohol sales data is crucial to ensuring an adequate ARIMA model is fitted to the data. The off-trade alcohol sales data follow a strong seasonal trend (see Figure 1 on page 8). Correlogram statistics enabled the correlation between error terms at different lag time periods to be identified.[31] Table A1.1 shows that, for example, the correlation between the current value of total alcohol sales and its value one week ago (lag 1) is 0.66 i.e. 66% of current sales are explained by alcohol sales the previous week (serial correlation). A similarly strong correlation (0.64) was observed between the current value of alcohol sales and its value 52 weeks ago (lag 52). In other words, 64% of current alcohol sales are explained by sales a year previously (seasonal correlation). This reflects the strong seasonal pattern of the data, peaking each year in December. Additional white-noise tests (Q statistics) for all alcohol sales estimates confirmed that there was significant serial correlation between residuals ($P<0.01$).[32] An ARIMA model fitted to the data must account for this serial and seasonal correlation.

Table A1.1: Sample of autocorrelation statistics for time series of total off-trade alcohol sales in Scotland.

Lag time (weeks)	Autocorrelation	P-value
1	0.66	<0.001
2	0.26	<0.001
3	0.09	<0.001
51	0.41	<0.001
52	0.63	<0.001
53	0.44	<0.001
54	0.19	<0.001

Tests for stationarity

In addition to establishing the seasonal structure of the alcohol sales data, it must also be ensured that the data are stationary i.e. statistical properties such as the mean, variance and autocorrelation must be constant over time. The stationarity properties of the data were assessed using unit root tests. A Dickey-Fuller Generalised Least Squares test (DF GLS) was used to assess stationarity.[33] The null hypothesis of 'there is a unit root' was rejected for lags 1 and 2, since the test statistics were smaller than the critical values at 5%, i.e. sales are stationary. However, for the remaining lags (3 to 52) the null hypothesis of a unit root could not be rejected at 5% suggesting non-stationarity. Based on Ng and Perron criterion[34], the optimal lag was at 52 weeks.

The DF GLS test was supplemented by the Phillips Perron test, which has the same null hypothesis of a unit root. The test statistics were smaller at all common significance levels, meaning the null hypothesis of a unit root was rejected i.e. the data are stationary. For additional robustness, the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test was performed. This test is often carried out in conjunction with the DF GLS and the Phillips Perron test, but it differs in that it takes the null hypothesis of stationarity, i.e. no unit root. For each time lag the test statistic was smaller than the 5% critical value, thus the null hypothesis of stationarity could not be rejected.

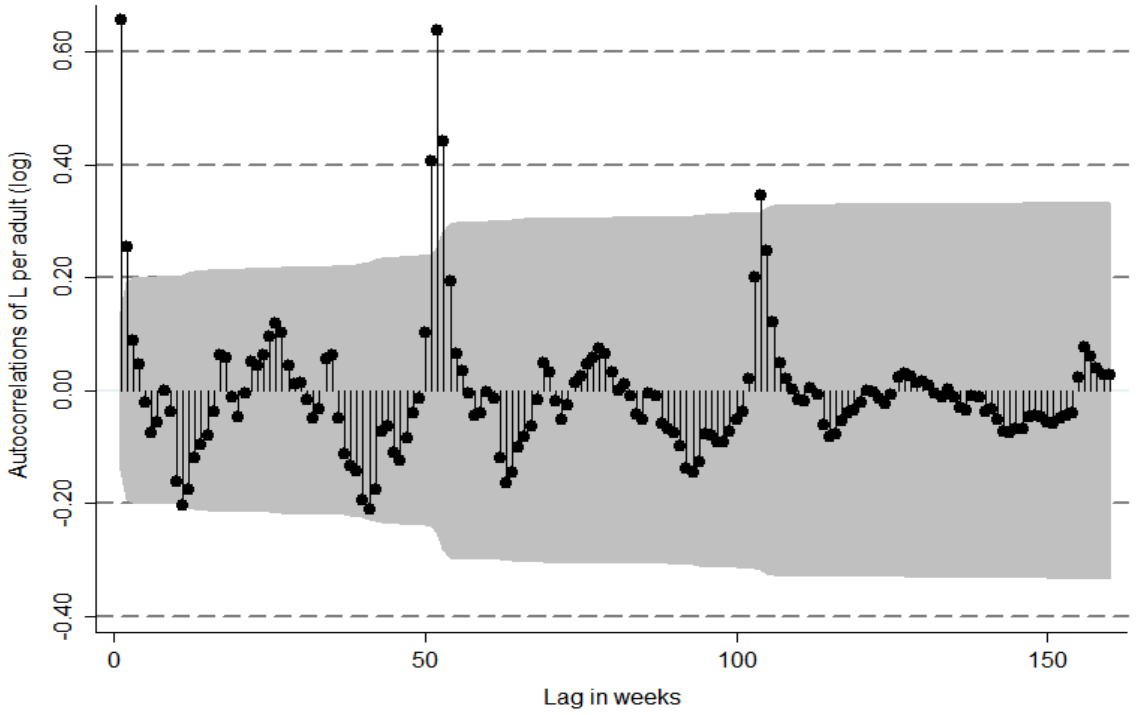
Although these unit roots tests offer important insights as to the properties of the alcohol sales data, they usually have low power if the time-series shows structural breaks or outliers. Annual alcohol sales in December could be argued to present such breaks or outliers. An autocorrelation plot can therefore provide a stronger indication as to the presence of stationarity.

Autocorrelation plots

If a time-series is non-stationary the plot would show a very slow exponential decay of autocorrelations over time, which was not the case for the off-trade alcohol sales data (Figure A1.2). This indicates that there was no secular trend in off-trade alcohol sales in Scotland and England & Wales (data not shown) over this three year period. However, what was evident from the autocorrelation plots is that the data show seasonal non-stationarity i.e. at the lags of seasonality the spikes (around Christmas) are not diminishing quickly and all three seasonal spikes (and adjacent data points) are significant with the first two being

nearly identical in magnitude. In contrast, the shape of the 'low' lags shows a very different pattern, as these reduce sharply and are insignificant. This provides strong evidence of seasonal non-stationarity but overall stationarity.

Figure A1.2: Autocorrelation plot of off-trade alcohol sales (L per adult (log)) in Scotland.



The ARIMA model

The modelling strategy consisted of initially modelling the off-trade alcohol sales data time-series to obtain an adequate preliminary model and then modelling and testing the effect of the intervention (i.e the Alcohol Act).[35] Several candidate models were investigated using graphs and autocorrelation plots of the stationary time-series and the most appropriate and parsimonious model was selected using the Akaike Information Criterion (AIC).[36] For analyses of all alcohol time-series and promotional sales, the final fitted model was a seasonal ARIMA (SARIMA) with first differencing at lag 1 and seasonal differencing at lag 52. Seasonal differencing at lag 52 meant that data points for each week in 2009 were not included in the analyses.

In order to analyse the magnitude and statistical significance of the effect that the Alcohol Act had on alcohol sales per adult in Scotland, a binary explanatory variable was included in the SARIMA models, with the value of zero for the time before the ban was introduced (01/09 until 09/11) and the value of one after the introduction of the ban (10/11 until 09/12). In England & Wales the Alcohol Act was not introduced, but the same explanatory variable was included in analyses to enable a comparison of any differences in alcohol sales with and without the Act. Adjusted analyses to control for the potential effects of household disposable income, alcohol prices, on-trade alcohol sales and sales/promotions of other drink types were also performed.

After the models were fitted, AIC and Bayesian Information Criterion (BIC) statistics were obtained and compared. In addition, Ordinary Least Square (OLS) regression analyses were

run with predicted values as the explanatory variable and observed values as the dependent variable to obtain Adjusted R^2 values.
Plots of predicted versus observed values from the SARIMA models (Figures A1.3-A1.6) and test statistics for the OLS regressions confirmed the specified models to fit the data well.

Figure A1.3: Plot of observed versus predicted log values of off-trade alcohol sales in Scotland (unadjusted).

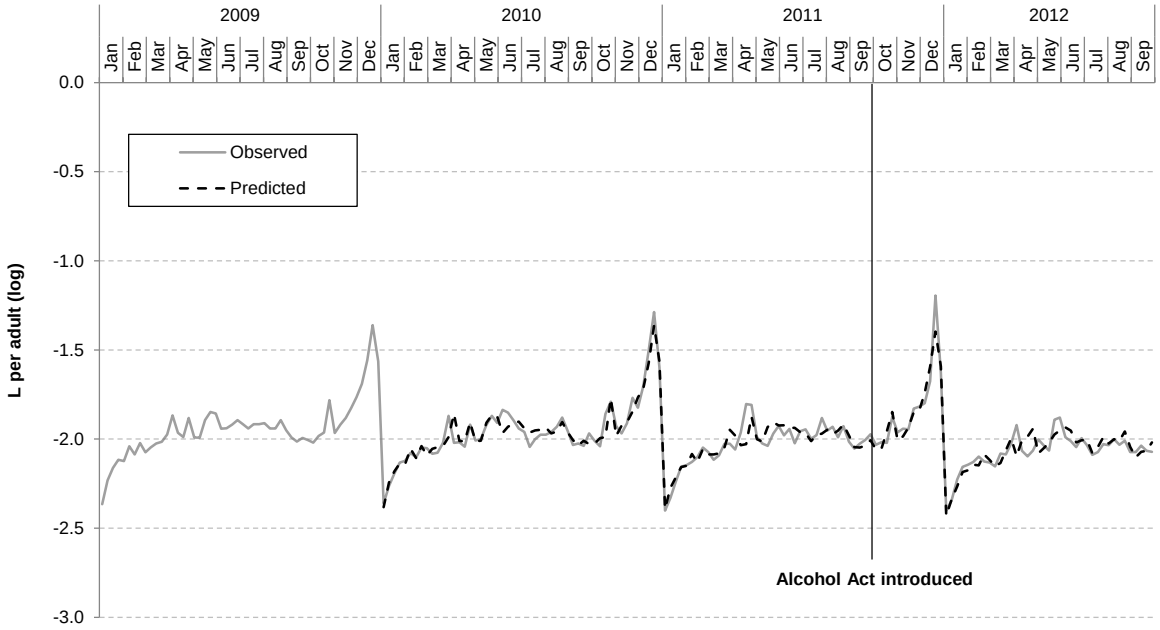


Figure A1.4: Plot of observed versus predicted log values of off-trade alcohol sales in Scotland obtained (adjusted for disposable income, mean sales price and on-trade alcohol sales).

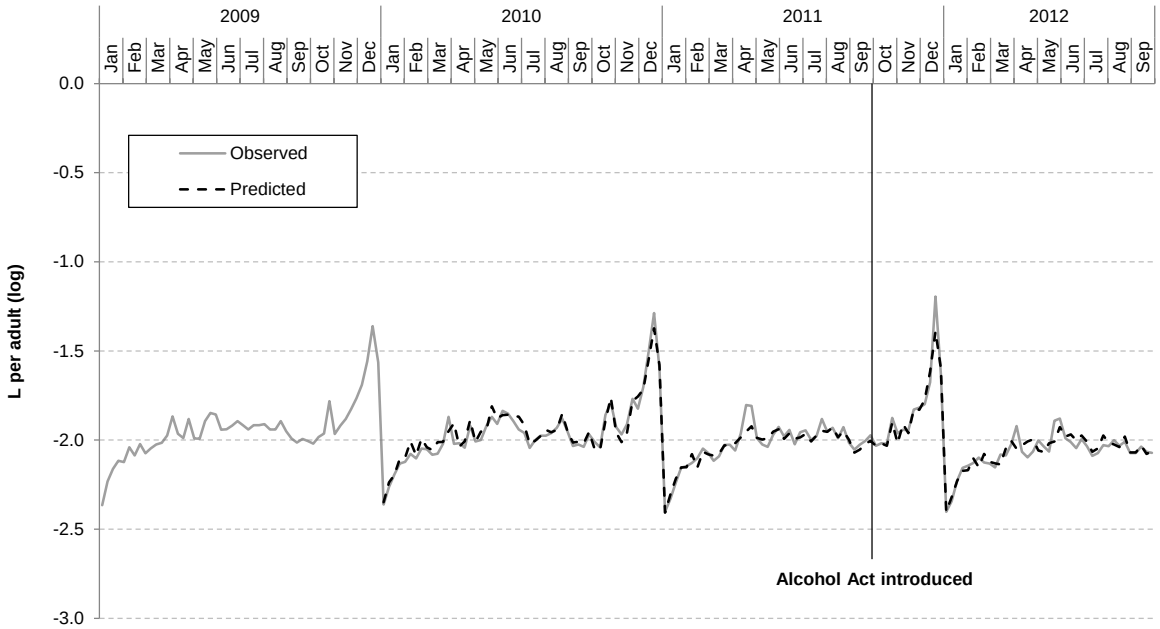


Figure A1.5: Plot of observed versus predicted log values of off-trade alcohol sales in England & Wales (unadjusted).

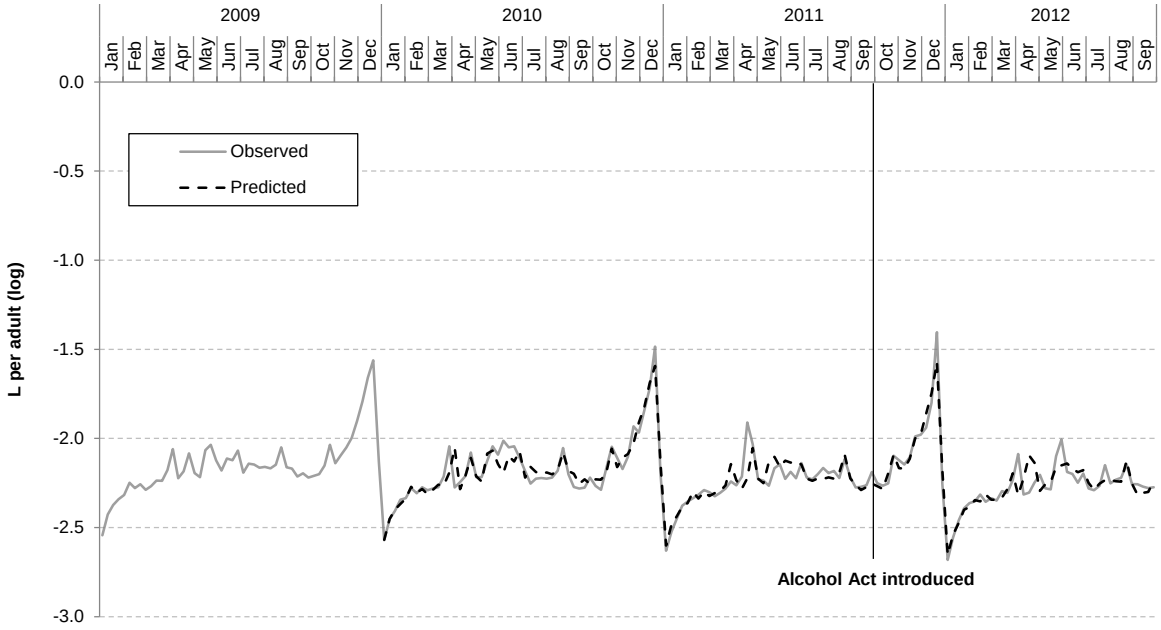


Figure A1.6: Plot of observed versus predicted log values of off-trade alcohol sales in England & Wales obtained (adjusted for disposable income, mean sales price and on-trade alcohol sales).

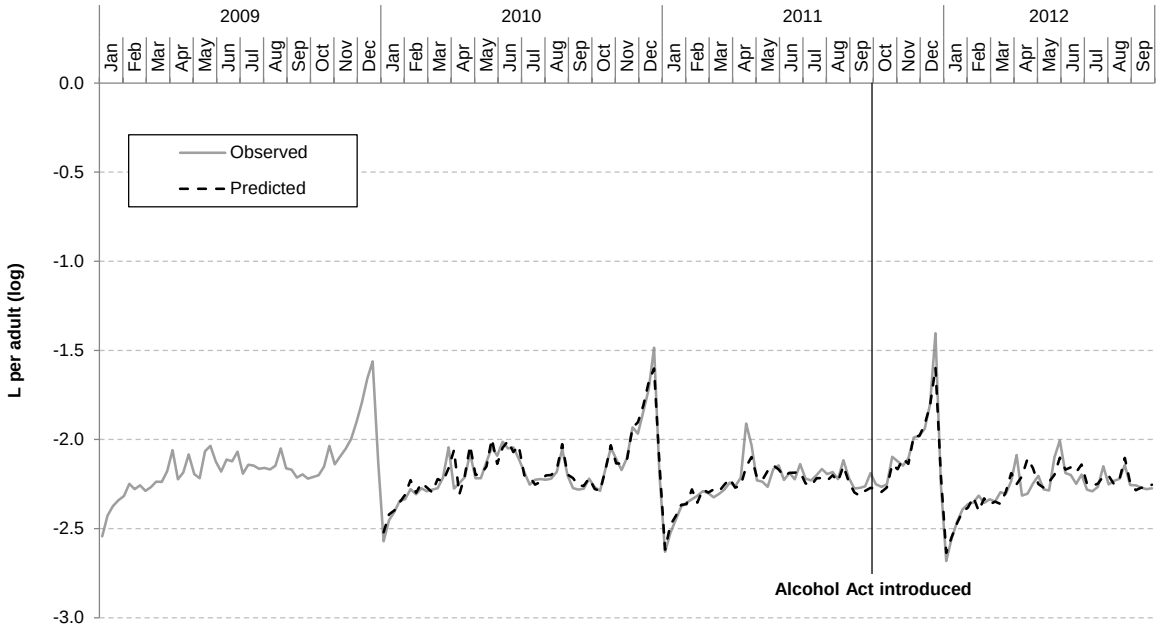


Table A1.2: SARIMA(X) for the association between the Alcohol Act and off-trade alcohol sales per adult in Scotland.

	% change	95% CI			P-value	AIC	BIC	Adjusted R^2 (%)
All alcohol								
Unadjusted	-2.4	-5.1	to	0.4	0.09	-408	-393	88
Adjusted model 1	-2.6	-5.3	to	0.2	0.07	-476	-452	93
Adjusted model 2	-2.4	-5.2	to	0.6	0.11	-404	-381	89
Beer								
Unadjusted	-2.1	-7.4	to	3.5	0.45	-233	-219	77
Adjusted model 1	-1.1	-3.7	to	1.5	0.40	-450	-423	95
Adjusted model 2	1.0	-3.6	to	5.8	0.68	-305	-278	86
Wine								
Unadjusted	-4.5	-6.4	to	-2.6	<0.001	-507	-492	91
Adjusted model 1	-4.0	-5.4	to	-2.6	<0.001	-558	-532	94
Adjusted model 2	-4.0	-5.4	to	-2.6	<0.001	-558	-532	94
Spirits								
Unadjusted	-1.2	-4.1	to	1.9	0.45	-346	-331	86
Adjusted model 1	-0.2	-2.7	to	2.3	0.87	-505	-479	96
Adjusted model 2	0.5	-1.8	to	2.9	0.67	-378	-351	89
Cider & perry								
Unadjusted	-2.6	-8.0	to	3.2	0.37	-273	-258	78
Adjusted model 1	-0.4	-4.5	to	3.9	0.86	-354	-328	88
Adjusted model 2	0.2	-3.4	to	3.9	0.91	-346	-319	88
RTDs								
Unadjusted	-15.2	-21.7	to	-8.2	<0.001	-260	-245	87
Adjusted model 1	-8.5	-12.7	to	-4.1	<0.001	-333	-306	93
Adjusted model 2	-13.3	-17.9	to	-8.5	<0.001	-320	-293	92

Notes: Off-trade sales data exclude discount retailers. All analyses account for underlying secular and seasonal trends. Adjusted model 1 includes adjustment for changes in disposable income, alcohol price (mean sales price), on-trade alcohol sales and, for models where the outcome variable was a particular drink type, per adult off-trade sales of all other drink types combined. Adjusted model 2 is the same as adjusted model 1, but mean sales price is replaced by the alcohol price index.

Table A1.3: SARIMA(X) regression output for the association between the Alcohol Act and off-trade alcohol sales per adult in England & Wales.

	% change	95% CI			P-value	AIC	BIC	Adjusted R^2 (%)
All alcohol								
Unadjusted	-0.5	-3.6	to	2.7	0.78	-364	-349	85
Adjusted model 1	-0.5	-4.6	to	3.9	0.83	-406	-382	89
Adjusted model 2	-1.1	-6.1	to	4.1	0.67	-359	-335	85
Beer								
Unadjusted	1.4	-5.2	to	8.4	0.70	-213	-198	74
Adjusted model 1	3.4	-1.0	to	8.0	0.14	-430	-403	95
Adjusted model 2	5.5	0.2	to	11.1	0.04	-299	-272	87
Wine								
Unadjusted	0.1	-1.8	to	2.0	0.96	-451	-436	86
Adjusted model 1	-0.8	-2.7	to	1.2	0.42	-520	-493	92
Adjusted model 2	-1.3	-3.3	to	0.7	0.19	-516	-489	92
Spirits								
Unadjusted	-1.3	-4.4	to	1.8	0.41	-327	-312	88
Adjusted model 1	-1.5	-4.2	to	1.3	0.30	-442	-415	95
Adjusted model 2	-2.7	-5.2	to	0.0	0.05	-392	-366	92
Cider & perry								
Unadjusted	-3.8	-10.3	to	3.0	0.27	-262	-247	70
Adjusted model 1	-1.3	-5.1	to	2.7	0.53	-410	-383	92
Adjusted model 2	-1.2	-5.0	to	2.7	0.53	-411	-384	92
RTDs								
Unadjusted	-11.7	-19.1	to	-3.6	0.005	-246	-231	87
Adjusted model 1	-2.3	-7.3	to	3.0	0.38	-369	-342	95
Adjusted model 2	-8.7	-14.0	to	-3.1	0.003	-340	-313	93

Notes: Off-trade sales data exclude discount retailers. All analyses account for underlying secular and seasonal trends. Adjusted model 1 includes adjustment for changes in disposable income, alcohol prices (mean sales price), on-trade alcohol sales and, for models where the outcome variable was a particular drink type, per adult off-trade sales of all other drink types combined. Adjusted model 2 is the same as adjusted model 1, but mean sales price is replaced by the alcohol price index.

Table A1.4: SARIMA(X) regression output for the association between the Alcohol Act and the proportion of off-trade alcohol sold on promotion in Scotland.

	% change	95% CI			P-value	AIC	BIC	Adjusted R^2 (%)
All alcohol								
Unadjusted	-8.4	-17.7	to	2.0	0.11	-141	-128	55
Adjusted model 1	-11.3	-19.5	to	-2.3	0.02	-202	-181	73
Adjusted model 2	-4.3	-16.8	to	10.1	0.54	-138	-117	55
Beer								
Unadjusted	-9.0	-22.2	to	6.6	0.24	-71	-57	49
Adjusted model 1	-12.2	-22.3	to	-0.9	0.04	-170	-146	78
Adjusted model 2	-0.0	-13.6	to	15.6	0.10	-124	-100	68
Wine								
Unadjusted	-7.5	-14.6	to	0.3	0.06	-226	-213	26
Adjusted model 1	-6.7	-12.5	to	-0.7	0.03	-252	-228	40
Adjusted model 2	-5.6	-12.7	to	2.1	0.15	-229	-205	28
Spirits								
Unadjusted	-7.6	-20.9	to	8.0	0.32	-72	-59	66
Adjusted model 1	-3.6	-15.0	to	9.3	0.56	-154	-130	85
Adjusted model 2	-6.8	-22.0	to	11.4	0.44	-73	-49	69
Cider & perry								
Unadjusted	-6.2	-21.7	to	12.4	0.49	-39	-26	41
Adjusted model 1	1.1	-13.0	to	17.4	0.89	-119	-95	66
Adjusted model 2	11.1	-7.7	to	33.8	0.27	-120	-97	66
RTDs								
Unadjusted	-23.5	-37.8	to	-6.0	0.01	-95	-82	70
Adjusted model 1	-25.7	-37.5	to	-11.7	0.001	-116	-92	77
Adjusted model 2	-23.8	-39.1	to	-4.8	0.02	-101	-78	74

Notes: Off-trade sales data exclude discount retailers. All analyses account for underlying secular and seasonal trends. Adjusted model 1 includes adjustment for changes in disposable income, alcohol prices (mean sales price), on-trade alcohol sales and, for models where the outcome variable was a particular drink type, the proportion of all other drink types sold on promotion (combined). Adjusted model 2 is the same as adjusted model 1, but mean sales price is replaced by the alcohol price index.

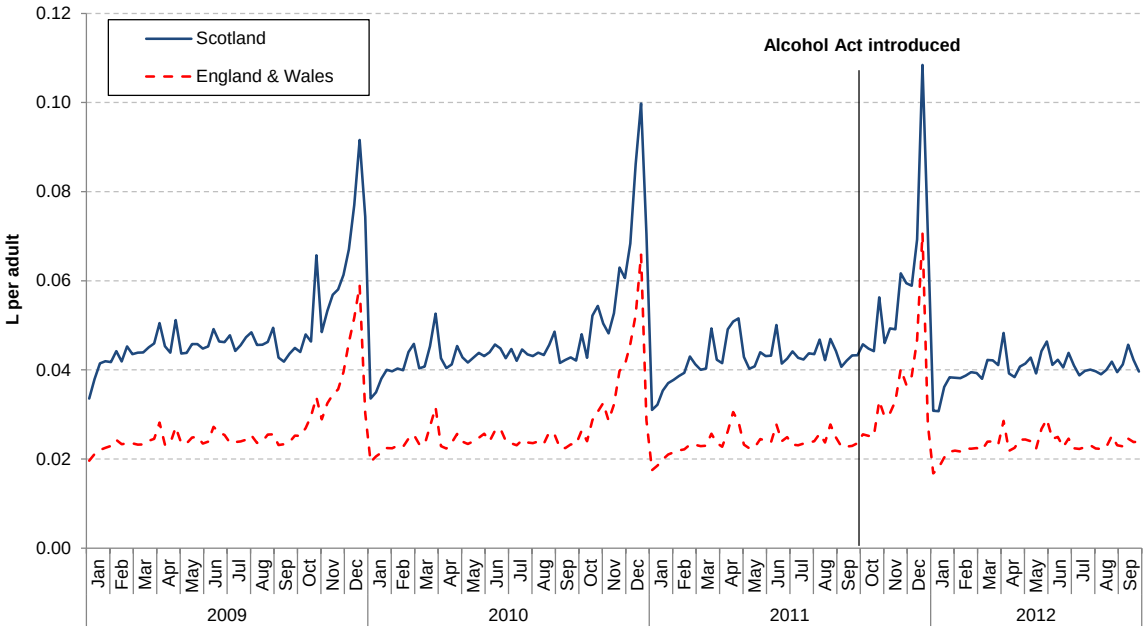
Table A1.5: SARIMA(X) regression output for the association between the Alcohol Act and the proportion of off-trade alcohol sold on promotion in England & Wales.

	% change	95% CI			P-value	AIC	BIC	Adjusted R^2 (%)
All alcohol								
Unadjusted	-7.2	-14.9	to	1.2	0.09	187	-173	63
Adjusted model 1	-10.4	-17.2	to	-2.9	0.007	-248	-227	78
Adjusted model 2	-5.0	-16.6	to	8.1	0.43	-185	-164	64
Beer								
Unadjusted	-12.1	-22.1	to	-0.7	0.04	-119	-106	46
Adjusted model 1	-14.7	-22.6	to	-6.0	0.001	-213	-189	80
Adjusted model 2	-5.6	-16.5	to	6.8	0.36	-149	-125	66
Wine								
Unadjusted	-0.1	-6.4	to	6.6	0.98	-216	-202	27
Adjusted model 1	-1.5	-8.1	to	5.7	0.68	-261	-238	53
Adjusted model 2	-3.3	-11.2	to	5.3	0.44	-211	-188	29
Spirits								
Unadjusted	-7.4	-19.0	to	5.8	0.26	-85	-72	69
Adjusted model 1	-14.9	-27.0	to	-0.8	0.04	-133	-109	86
Adjusted model 2	-17.1	-29.3	to	-2.9	0.02	-94	-70	80
Cider & perry								
Unadjusted	1.1	-13.5	to	18.3	0.89	-79	-66	54
Adjusted model 1	17.0	1.4	to	35.1	0.03	-164	-141	74
Adjusted model 2	19.7	1.7	to	40.8	0.03	-155	-131	73
RTDs								
Unadjusted	-8.1	-23.5	to	10.4	0.37	-144	-131	65
Adjusted model 1	-11.3	-21.6	to	0.5	0.06	-173	-149	74
Adjusted model 2	-12.1	-26.2	to	4.8	0.15	-147	-123	67

Notes: Off-trade sales data exclude discount retailers. All analyses account for underlying secular and seasonal trends. Adjusted model 1 includes adjustment for changes in disposable income, alcohol prices (mean sales price), on-trade alcohol sales and, for models where the outcome variable was a particular drink type, the proportion of all other drink types sold on promotion (combined). Adjusted model 2 is the same as adjusted model 1, but mean sales price is replaced by the alcohol price index.

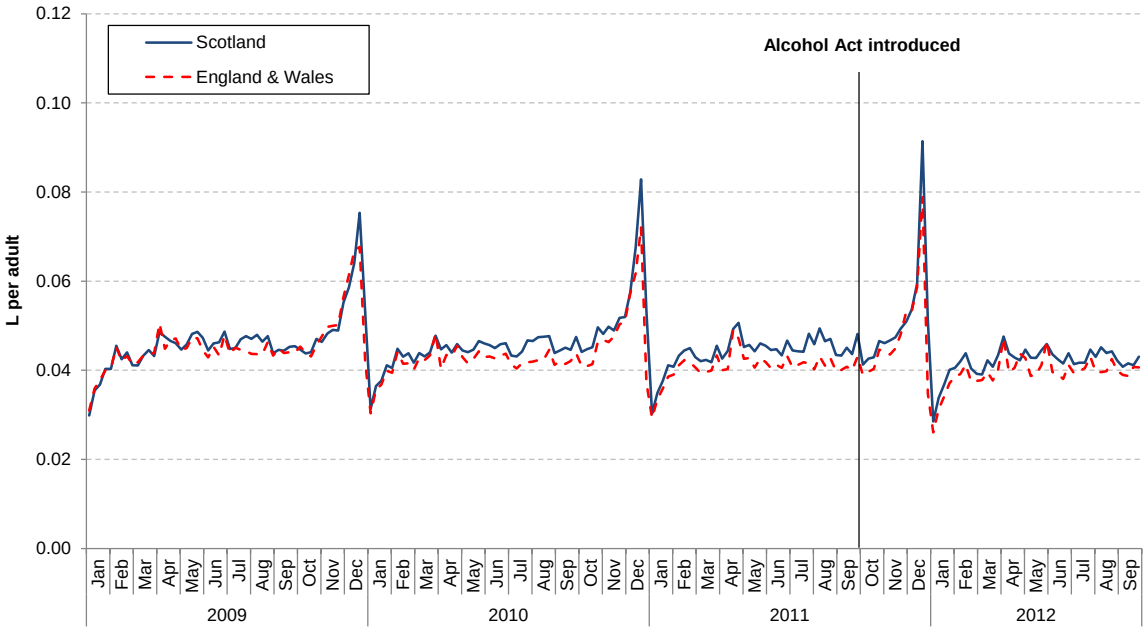
Appendix 2: Additional charts showing trends in off-trade alcohol sales and the proportion of alcohol sold on promotion, by drink type

Figure A2.1: Volume of pure alcohol sold off-trade as spirits per adult per week in Scotland and England & Wales, January 2009-September 2012.



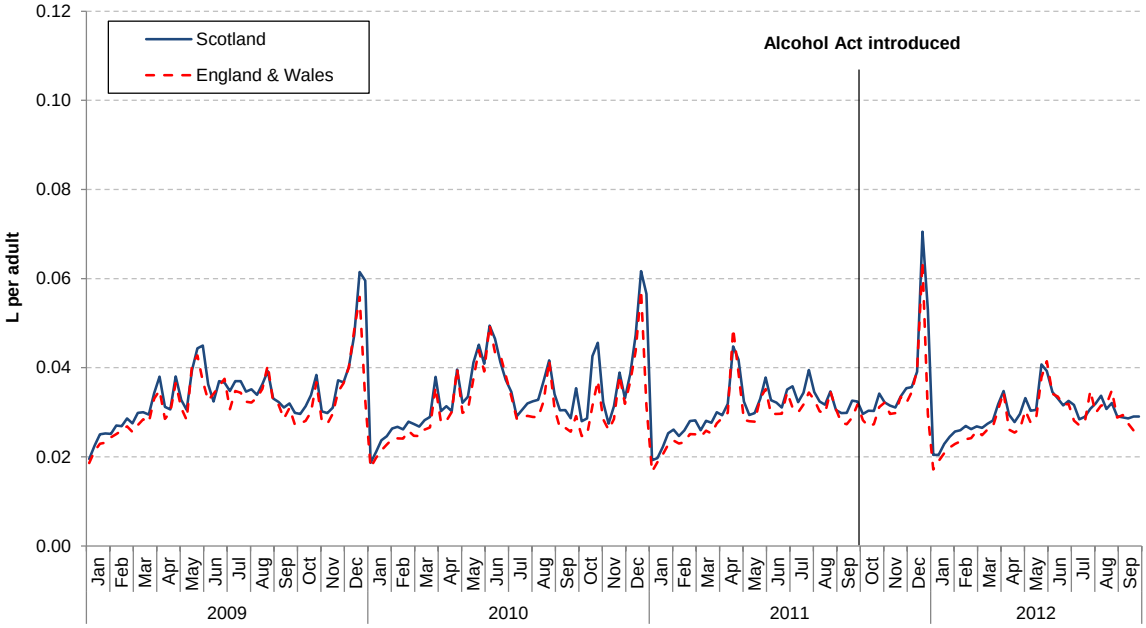
Notes: Off-trade sales data exclude discount retailers.

Figure A2.2: Volume of pure alcohol sold off-trade as wine per adult per week in Scotland and England & Wales, January 2009-September 2012.



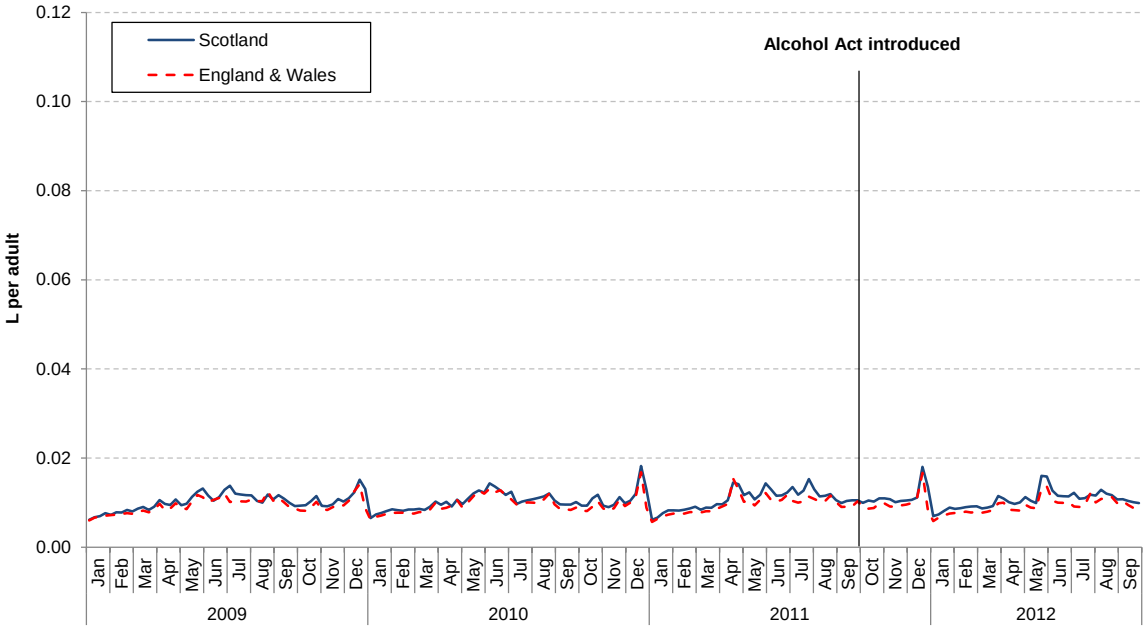
Notes: Off-trade sales data exclude discount retailers.

Figure A2.3: Volume of pure alcohol sold off-trade as beer per adult per week in Scotland and England & Wales, January 2009-September 2012.



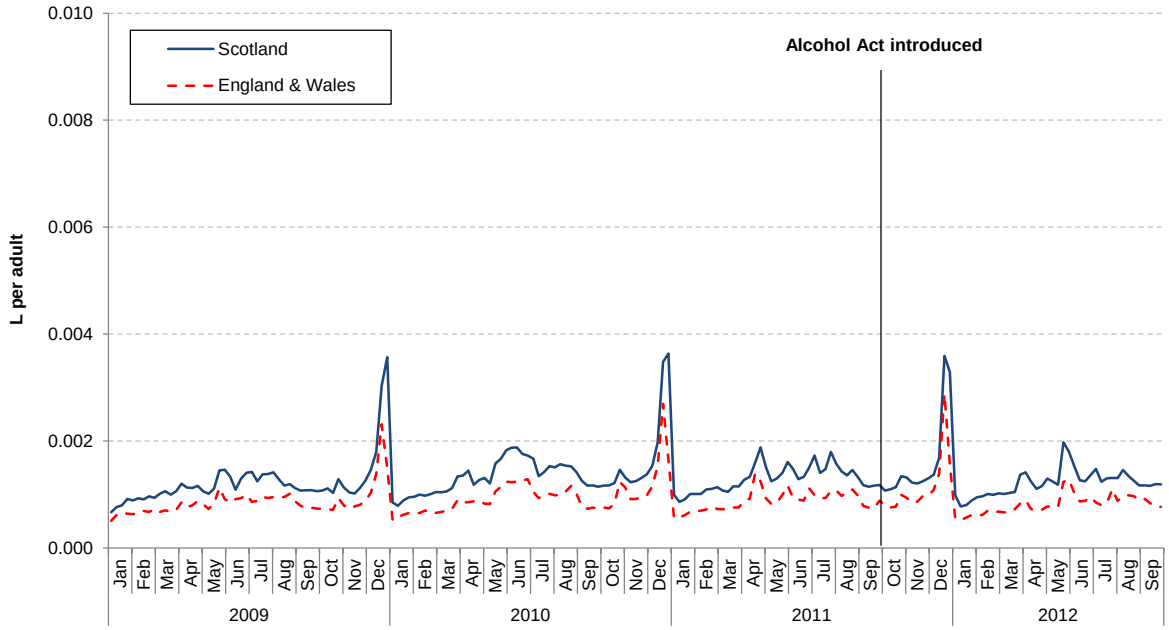
Notes: Off-trade sales data exclude discount retailers.

Figure A2.4: Volume of pure alcohol sold off-trade as cider/perry per adult per week in Scotland and England & Wales, January 2009-October 2012.



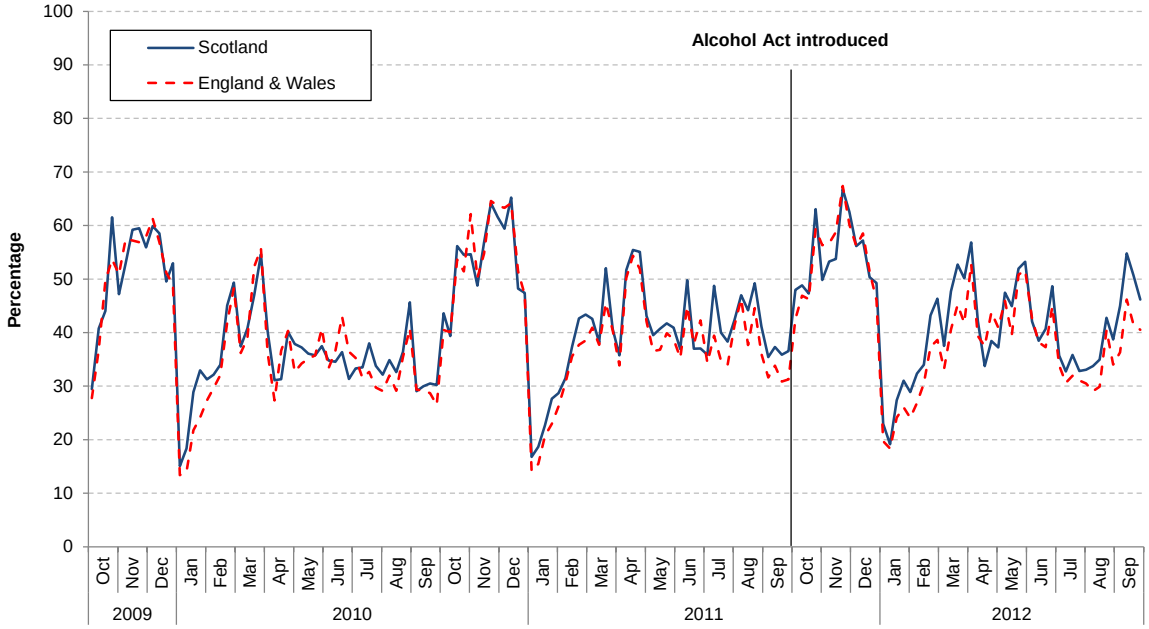
Notes: Off-trade sales data exclude discount retailers.

Figure A2.5: Volume of pure alcohol sold off-trade as RTDs per adult per week in Scotland and England & Wales, January 2009-September 2012.



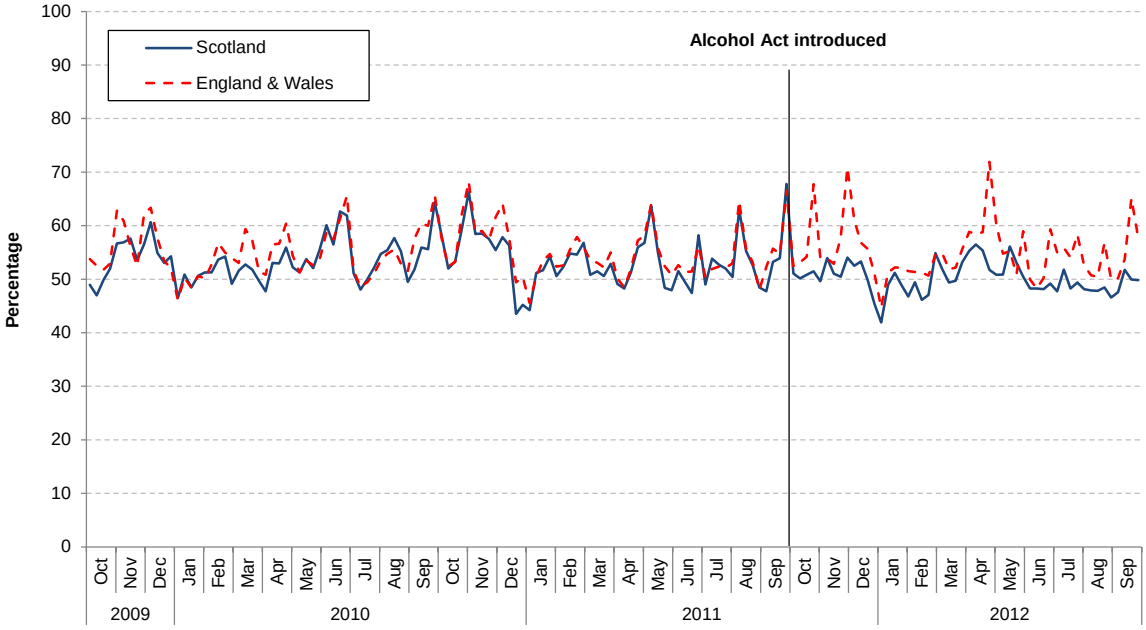
Notes: Off-trade sales data exclude discount retailers. Due to the very low volume of RTDs sold, the y-axis scale is not consistent with Figures A2.1 to A2.4.

Figure A2.6: Percentage of off-trade spirits sold on promotion per week in Scotland and England & Wales, October 2009-September 2012.



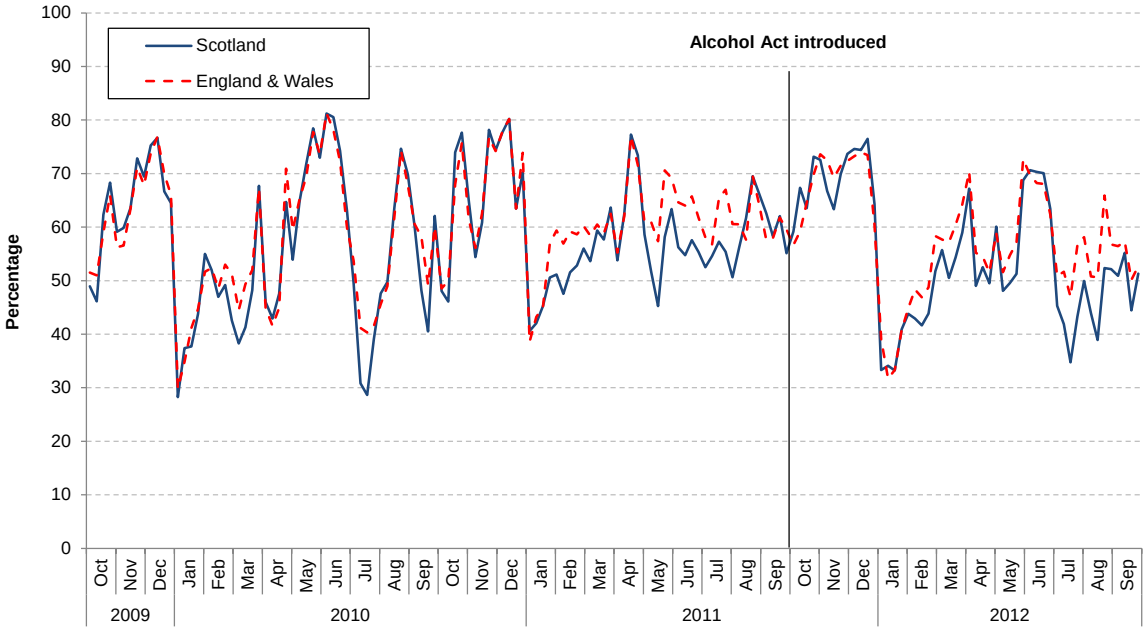
Notes: Off-trade sales data exclude discount retailers. Data are based on alcohol sales in large multiple grocers only and encompass all types of promotional activity.

Figure A2.7: Percentage of off-trade wine sold on promotion per week in Scotland and England & Wales, October 2009-September 2012.



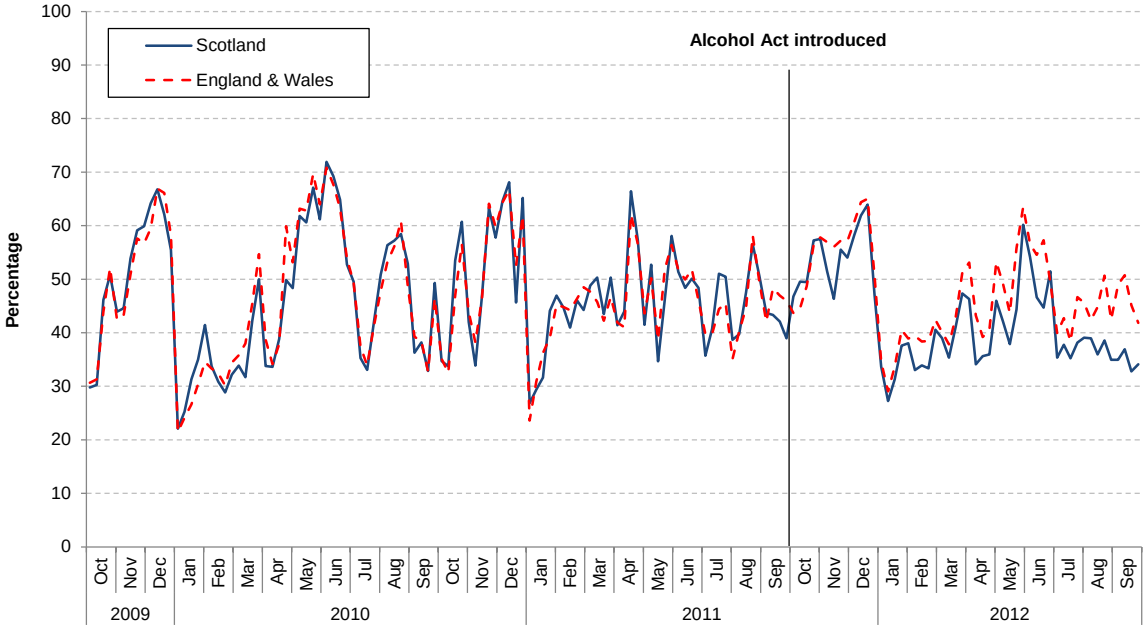
Notes: Off-trade sales data exclude discount retailers. Data are based on alcohol sales in large multiple grocers only and encompass all types of promotional activity.

Figure A2.8: Percentage of off-trade beer sold on promotion per week in Scotland and England & Wales, October 2009-September 2012.



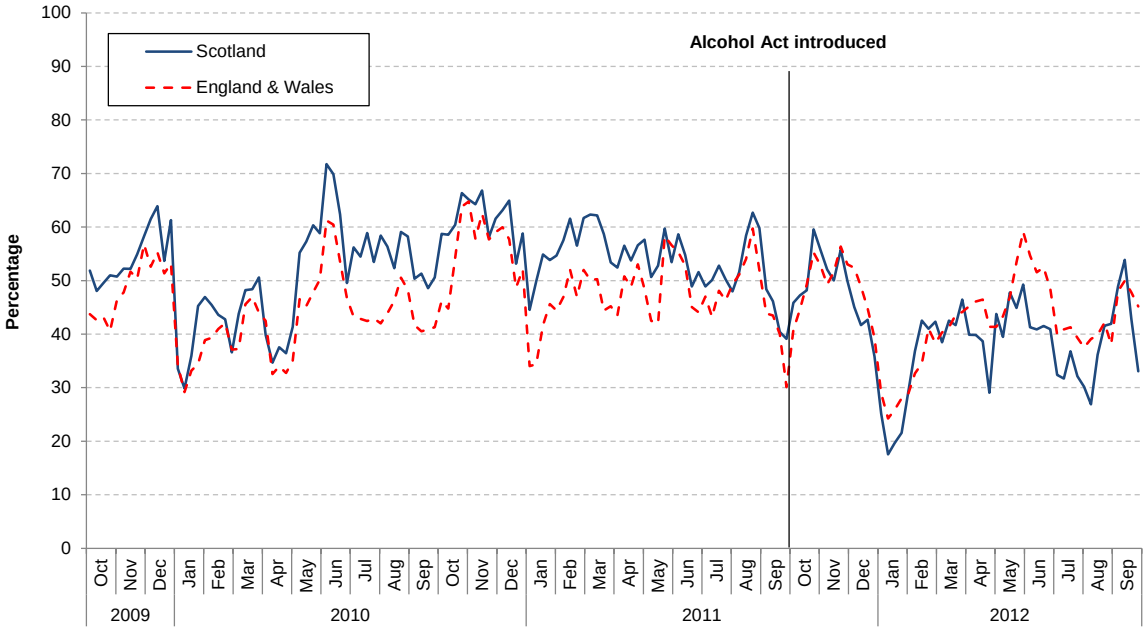
Notes: Off-trade sales data exclude discount retailers. Data are based on alcohol sales in large multiple grocers only and encompass all types of promotional activity.

Figure A2.9: Percentage of off-trade cider/perry sold on promotion per week in Scotland and England & Wales, October 2009-September 2012.



Notes: Off-trade sales data exclude discount retailers. Data are based on alcohol sales in large multiple grocers only and encompass all types of promotional activity.

Figure A2.10: Percentage of off-trade RTDs sold on promotion per week in Scotland and England & Wales, October 2009-September 2012.



Notes: Off-trade sales data exclude discount retailers. Data are based on alcohol sales in large multiple grocers only and encompass all types of promotional activity.

References

All web links were verified as working on 8th May 2013.

1. Scottish Government. Changing Scotland's relationship with alcohol: A framework for action [online]. Edinburgh: Scottish Government; 2009. www.scotland.gov.uk/Publications/2009/03/04144703/0
2. Scottish Parliament. Alcohol Licensing (Scotland) Act. Edinburgh: Scottish Parliament; 2005. www.legislation.gov.uk/asp/2005/16/contents
3. Scottish Parliament. Alcohol etc. (Scotland) Act [as passed]. Edinburgh: Scottish Parliament; 2010. www.scottish.parliament.uk/S3_Bills/Alcohol%20etc.%20(Scotland)%20Bill/b34bs3-aspassed.pdf
4. Scottish Parliament. Alcohol (Minimum Pricing) (Scotland) Act. Edinburgh: Scottish Parliament; 2012. www.legislation.gov.uk/asp/2012/4/introduction/enacted
5. Beeston C, Robinson M, Craig N, Graham L. Monitoring and Evaluating Scotland's Alcohol Strategy. Setting the scene: Theory of change and baseline picture. Edinburgh: NHS Health Scotland; 2011. www.healthscotland.com/documents/5072.aspx
6. Curnock E, Robinson M, McCartney G, Craig N, Beeston C. Monitoring and Evaluating Scotland's Alcohol Strategy: Preliminary analysis of the impact of the quantity discount ban on off-trade alcohol sales in Scotland. Edinburgh: NHS Health Scotland; 2012. www.healthscotland.com/documents/5923.aspx
7. Home Office. A consultation on delivering the Government's policies to cut alcohol fuelled crime and anti-social behaviour. London: Home Office; 2012. www.gov.uk/government/uploads/system/uploads/attachment_data/file/157755/alcohol-consultation-document.pdf
8. Thorpe R, Robinson M, McCartney G, Beeston C. Monitoring and Evaluating Scotland's Alcohol Strategy: A review of the validity and reliability of alcohol retail sales data for the purpose of Monitoring and Evaluating Scotland's Alcohol Strategy. Edinburgh: NHS Health Scotland; 2011. www.healthscotland.com/documents/5761.aspx
9. Rabinovich L, Brutscher P-B, de Vries H, Tiessen J, Clift J, Reding A. The affordability of alcoholic beverages in the European Union: understanding the link between alcohol affordability, consumption and harms. Cambridge: RAND Europe; 2009. http://www.rand.org/pubs/technical_reports/TR689.html
10. Scottish Government. Scottish National Accounts 2012 Quarter 3. Table 16: Households and Non-Profit Institutions Serving Households. http://www.scotland.gov.uk/Topics/Statistics/Browse/Economy/SNAP
11. Office for National Statistics. United Kingdom Economic Accounts, Income and capital accounts: Households and non-profit institutions serving. http://www.ons.gov.uk/ons/datasets-and-tables/data-selector.html?cdid=QWND&dataset=ukea&table-id=A38
12. Office for National Statistics. Regional accounts methodology guide. Newport: Office for National Statistics; 2008. http://www.ons.gov.uk/ons/guide-method/method-quality/specific/economy/regional-accounts/index.html
13. Stockwell T, Zhao J, Giesbrecht N, Macdonald S, Thomas G, Wettlaufer A. The raising of minimum alcohol prices in Saskatchewan, Canada: impacts on consumption and implications for public health. *Am J Public Health* 2012; 102: e103-10.
14. Zhao J, Stockwell T, Martin G, Macdonald S, Vallance K, Treno A, Ponicki WR, Tu A, Buxton J.The Relationship between Minimum Alcohol Prices, Outlet Densities and Alcohol Attributable Deaths in British Columbia, 2002 to 2009. *Addiction* 2013. doi: 10.1111/add.12139. [Epub ahead of print]

15. Office for National Statistics. Consumer Price Indices time series dataset January 2013. www.ons.gov.uk/ons/rel/cpi/consumer-price-indices/january-2013/cpi-time-series-data.html
16. Brennan A, Purshouse R, Taylor K, et al. Modelling the potential impact of pricing and promotion policies for alcohol in England: results from the Sheffield Alcohol Policy Model Version 2008 (1-1). Independent review of the effect of Alcohol Pricing and Promotion: Part B. Sheffield: School of Health and Related Research, University of Sheffield; 2009. http://www.sheffield.ac.uk/scharr/sections/ph/research/alpol/publications
17. National Records of Scotland. Mid-year population estimates. www.gro-scotland.gov.uk/statistics/theme/population/estimates/mid-year/index.html
18. Office for National Statistics. Population estimates. www.statistics.gov.uk/hub/population/population-change/population-estimates
19. Ahmetoglu G, Fried S, Dawes J, Furnham A. Pricing practices: their effects on consumer behaviour and welfare. London: Mountain View Learning/Office for Fair Trading; 2010. http://www.oft.gov.uk/shared_oft/business_leaflets/659703/Advertising-of-prices/Pricing-Practices.pdf
20. Adams J, Beenstock J. Price discounts on alcohol in a city in Northern England. *Alcohol Alcohol* 2012; 47: 187-90.
21. Griffith R, Leicester A, O'Connell. Price-based measures to reduce alcohol consumption. IFS Briefing Note BN138. London: Institute for Fiscal Studies; 2013. www.ifs.org.uk/publications/6647
22. Meng Y, Hill-McManus D, Brennan A, Meier P. Model-based appraisal of alcohol minimum pricing and off-licensed trade discount bans in Scotland using the Sheffield Alcohol Policy Model (v 2): second update based on newly available data. Sheffield: School of Health and Related Research, University of Sheffield; 2012. www.sheffield.ac.uk/scharr/sections/ph/research/alpol/publications
23. BBC News. Scottish alcohol sales fall after multibuy ban. BBC News; 2011. http://www.bbc.co.uk/news/health-16097832
24. Stares H. The Scottish multi-buy ban one year on, what's happened? Oxford: The Nielsen Company; 2012.
25. World Health Organization. International guide for monitoring alcohol consumption and related harm. Geneva: World Health Organization; 2000. whqlibdoc.who.int/hq/2000/who_msd_msb_00.4.pdf
26. Results derived from Nielsen analysis of HomeScan data.
27. NHS Health Scotland analyses of the 2010 Scottish Health Survey.
28. Leicester A. Alcohol pricing and taxation policies. London: Institute for Fiscal Studies; 2011. www.ifs.org.uk/publications/5922
29. Greene WH. Econometric Analysis. Upper Saddle River, NJ: Prentice-Hall; 2008.
30. Box GEP, Jenkins GM, Reinsel GC. Time Series Analysis – Forecasting and Control. Upper Saddle River, NJ: Prentice-Hall; 1994.
31. Becketi S. Introduction to Time Series using STATA. Texas: STATA Press; 2013.
32. Box GEP, Pierce DA. Distribution of residual autocorrelations in autoregressive-integrated moving average time series models. *Journal of the American Statistical Association* 1970; 65(332): 1509-1526.
33. Elliott G, Rothenberg TJ, Stock JH. Efficient tests for an autoregressive unit root. *Econometrica* 1996; 64(4): 813–36.
34. Ng S, Perron P. Unit root tests in ARMA Models with data-dependent methods for the selection of the truncation lag. *Journal of the American Statistical Association* 1995; 90: 268-281.
35. McCain L, McCleary R. The statistical analysis of the simple interrupted time-series quasi-experiment, in quasi-experimentation: design & analysis issues for field settings. Cook T, Campbell D, eds. Rand McNally College Pub.Co; 1979.
36. Akaike H. A New Look at the Statistical Model Identification. *IEEE Transactions on Automatic Control* 1974;19:716–722.

www.healthscotland.com