

Evaluating the Impact of the Rural Fuel Duty Relief

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Thanks and acknowledgement are due to Professor Peter Urwin and Dr Franz Buscha from the University of Westminster, who have reviewed this evaluation and endorse the methodology.

Executive Summary

1. This evaluation finds that the rural fuel duty relief scheme has successfully reduced prices on the islands relative to the UK mainland. Pump prices for petrol and diesel fell relative to the mainland in March 2012 as a result of the introduction of the scheme and they have remained lower in all months since. Pump prices have consistently been 5ppl lower relative to the mainland in the latest quarter of data. Over the full period since March 2012 average prices have been around 4ppl lower on the islands, though there is uncertainty around the size of the effect and the evaluation finds no conclusive evidence that the effect is less than 5ppl. Overall this indicates that the policy is meeting its objective.
2. Under the pilot scheme, registered retailers in the Inner and Outer Hebrides, Northern Isles, islands in the Clyde and the Isles of Scilly are entitled to claim 5 pence per litre relief on fuel purchased after 1 January 2012 and were required from March 2012 to reduce the price of fuel they sell by an equivalent amount to the relief claimed.
3. This evaluation establishes whether the relief has reduced the pump price of petrol and diesel charged to consumers in the scheme at an aggregate level. The analysis also assesses: whether retailers have passed on the full value of the rebate to consumers; whether the effect of the rebate has differed between islands or fuel types; and whether competition has impacted prices in coastal towns on the mainland.
4. Difference in difference analysis is used to establish how pump prices in the islands have been affected by the introduction of the relief. In order to assess the pass-through to pump prices we have selected a control group of locations in mainland Scotland with similar features to the islands in the scheme. These locations provide an indication of what pump prices in the islands would have been had the relief not been in place.
5. Data on the pump price charged at each station in the scheme and in the control locations is provided by Experian Catalist through purchases made using the AllStar fuel card. The data is available monthly from January 2010 until August 2013 and is provided as an average pump price for all stations within five island groups and for ten control towns in Scotland.
6. The price differential between the islands and the mainland has changed over time and recent months have seen a larger reduction in the island prices compared to initial months in the scheme. Prices on the islands were on average 5ppl lower in the latest quarter of data than before the introduction of the relief, relative to the UK mainland.
7. Difference in difference analysis finds that prices have reduced by around 4ppl on average across all the islands compared to the mainland control locations since March 2012 (3.9ppl for petrol and 4.3ppl for diesel). It is likely that this average reduction is less than 5ppl because it captures prices of retailers both in and out of the scheme, as retailers have gradually joined the pilot. Methodological uncertainty means that the average reduction in the price differential found in the data may be lower than the actual level of price reduction passed on by retailers.
8. The data shows a varying effect of the scheme at an island level but there is a large degree of uncertainty surrounding this level of detail and we are not able to draw conclusions on individual islands. There have been no obvious competition effects on the coastal mainland locations.
9. These results provide strong evidence that the policy is meeting its objective of reducing the pump prices faced by motorists in the scheme. Following initial unsettled price behaviour, the differential has reduced over time as more retailers have joined and we might expect a greater average pass-through in future months. We consider the scheme to be effectively reducing prices on aggregate and that the evaluation is complete.

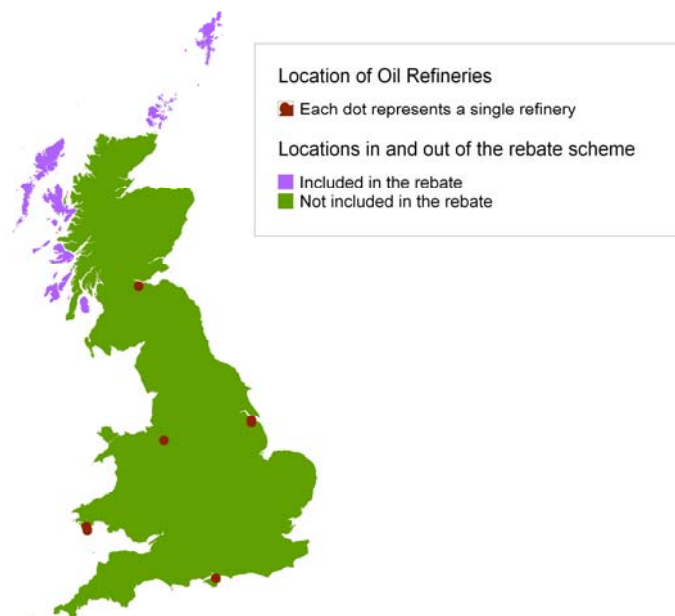
1. Introduction

1. In October 2010, the Government announced its intention to introduce a rural fuel duty relief pilot scheme for retailers of fuel in the Inner and Outer Hebrides, the Northern Isles, the islands in the Clyde and the Isles of Scilly. Registered retailers within these areas are entitled to claim 5 pence per litre (ppl) relief on fuel purchased after 1 January 2012 and were required from 1 March 2012 to reduce the price of fuel they sell by an equivalent amount to the relief claimed, to benefit consumers in the areas concerned.
2. The price of fuel on the Scottish islands has previously been around 10ppl higher on average than in other parts of the UK, and the Scilly Isles around 25ppl more, mainly as a result of increased transport and distribution costs. The objective of this relief is to offer some mitigation against the high costs of fuel in the specified areas and the required 5ppl reduction in pump prices offers compensation to consumers who are faced with these costs.
3. This paper describes the analysis that has been undertaken to establish the impact of the relief and examines whether the price of fuel in the scheme areas has reduced relative to the rest of the UK. This allows consideration of whether the scheme has been effective in reducing prices by 5ppl on average. Difference in difference estimation is used to estimate the effect of the relief over and above other factors affecting fuel price; in particular it has been used to compare the fuel price in the scheme to the price in similar locations on the Scottish mainland.

2. Background to the Policy

4. The Inner and Outer Hebrides, the Northern Isles, the islands in the Clyde and the Isles of Scilly were chosen for the pilot scheme because the price of fuel was notably higher in these locations than elsewhere in the UK. This is partly a result of the additional costs of selling fuel in these remote regions: delivery to the islands takes longer and covers a greater distance so costs are higher, and low populations mean that fixed costs are spread across a smaller volume of fuel sales. The map below demonstrates how these remote retailers are located further from refineries than the majority of the UK.

Map 1: Retailer Locations Relative to Refineries

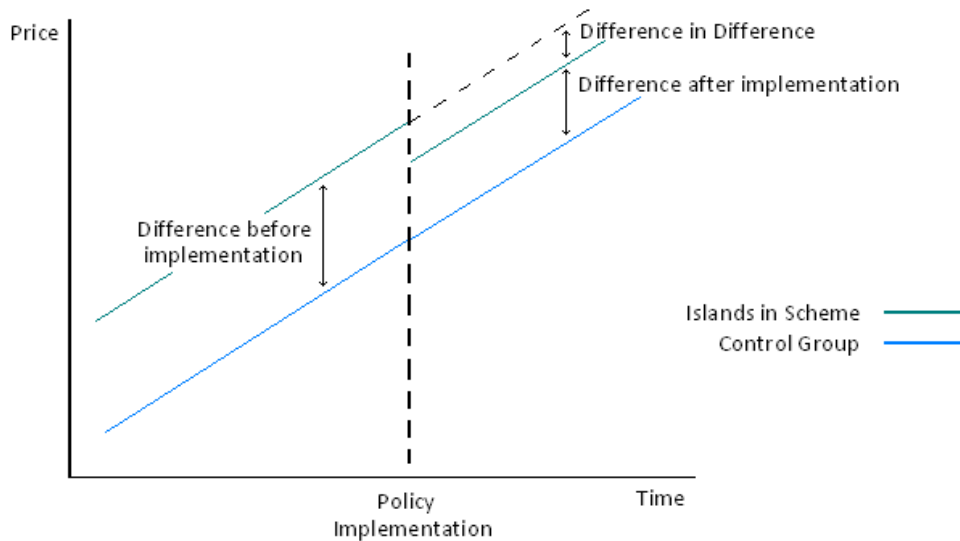


5. Fuel duty in the UK is applied at the point when fuel leaves an oil refinery. Retailers therefore pay the duty per litre of fuel they purchase from a refinery and pass this cost on to motorists in the pump price. Under this scheme they are able to claim 5ppl duty relief on purchases of unleaded petrol and diesel for retail sale within the eligible areas, and are entitled to claim the relief from HMRC on a monthly basis. After 60 days they are then required to reduce their pump prices by 5ppl compared to what they would have otherwise charged. There are currently 100 stations registered for the scheme and HMRC assesses all registrations and claims.
6. The key question addressed by this evaluation is whether the relief has reduced the pump price of petrol and diesel charged to consumers in the scheme. It will therefore consider the impact of the relief at an aggregate level across the islands compared to the mainland. It will not assess the pass-through of the rebate to consumers at an individual filling station level, as it would not be possible to collect enough data observations to suitably evaluate these small and remote stations.
7. Additional topics that will be addressed by this evaluation include assessing whether retailers have passed on the full value of the rebate to consumers, and whether the effect of the rebate has differed between islands or between fuel types. It will also consider whether competition has had an impact on prices in coastal towns on the mainland with ferry links to the islands in the scheme.

3. Methodology

3.1 Difference in Difference

8. Difference in difference analysis is used to establish how fuel prices in the islands have been affected by the introduction of the relief, relative to what their level might have been in absence of the scheme. Fuel pump prices have been on a general upward trend as a result of rising wholesale oil prices, although they fluctuate regularly. This means that a downwards trend in prices following the introduction of this scheme would not necessarily indicate successful implementation, and an upwards trend equally would not indicate a failure of retailers to pass on the relief.
9. To assess the pass-through to pump prices we have selected a control group of locations with similar features to the islands in the scheme. These locations provide an indication of what pump prices in the islands would have been had the relief not been in place. It is not necessary that the control locations had pump prices at exactly the same initial level as the islands, only that both sets of locations demonstrated the same trend in prices prior to implementation. This allows us to strip away other influences on the level of pump prices that affect both sets of locations, for example wholesale price changes.
10. A visual example of the results we would expect is shown in Diagram 1 below. This depicts a situation where the trends of pump prices in the scheme and control group are the same in the months prior to the introduction of the scheme. Pump prices in the islands begin at a higher level (analysis suggests they are around 10ppl higher than the rest of the UK) but behave in the same way. Following the introduction of the relief, pump prices in the control locations would be expected to continue along the same trend, shown by the blue line. If prices in the Islands behaved in a similar way before the scheme we could expect pump prices in the islands to continue rising along the same trend if no relief were in place, shown by the dotted black line. Any change in the movement of prices relative to this can be attributed to the introduction of the scheme.

Diagram 1: Example difference in difference results


3.2 Data Sources

11. Data on the pump price charged at each station on the islands in the scheme and in the control locations is provided by Experian Catalist. Experian collect pump price data through purchases made using the AllStar fuel card, which is an unbranded card accepted at around 85 per cent of UK filling stations¹. There are currently over 2 million of these cards in existence, the majority of which are held by travelling representatives who purchase fuel when it is needed anywhere across the country. The data indicates 103 filling stations which fall within the scheme areas that accept the card, but sites open and close regularly and this figure could change over time.
12. The data series used in this evaluation begins in January 2010 to allow a reasonable period of time before the implementation of the scheme to assess whether the islands and control group follow parallel trends in pump prices. The data is available monthly until August 2013 and is provided as an average pump price for all stations within the following five island groups²:
 1. Inner Hebrides
 2. Outer Hebrides
 3. Orkney Islands
 4. Shetland Islands
 5. Other Islands
13. Experian Catalist does not collect data for the very few stations on the Isles of Scilly and it is not possible to obtain data at the level required for an evaluation at this location. As these stations make up a small proportion of the total in the scheme, this should not affect results greatly.

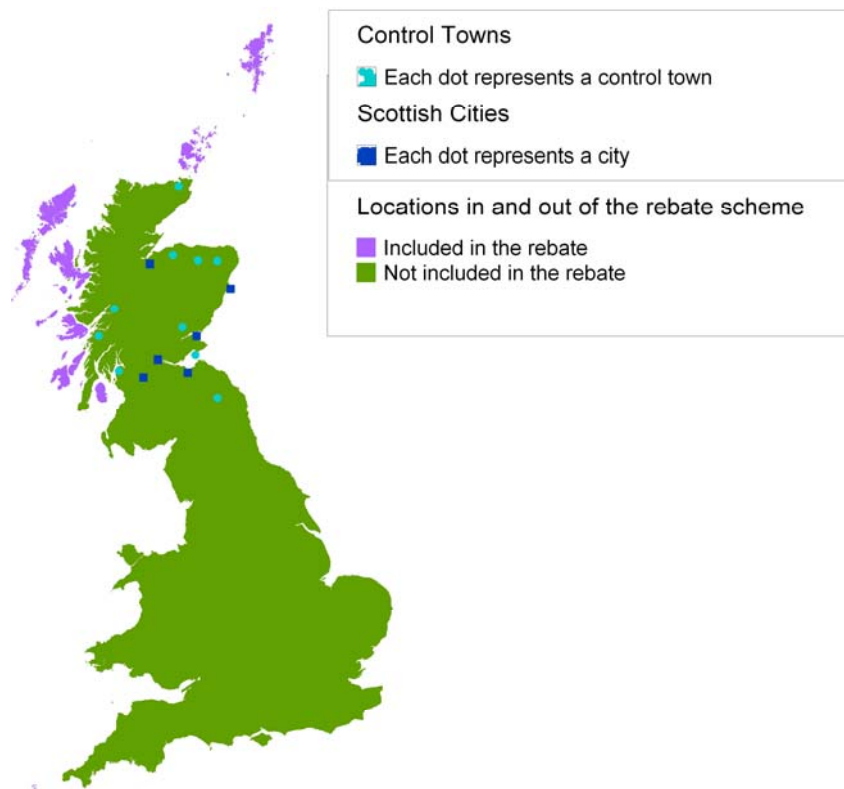
¹ These represent around 97 per cent of the total fuel volume sold in the UK.

² Refer to Annex A for a full list of locations within each island group.

3.3 Control group

14. In comparing the behaviour of pump prices in the scheme to those in the control locations, it is essential that the controls have similar characteristics to the islands. Annex C discusses the data used to select towns in mainland Scotland that exhibit similar relevant characteristics to the main town in each of the island groups in the scheme, and the chosen locations are shown on the map below.

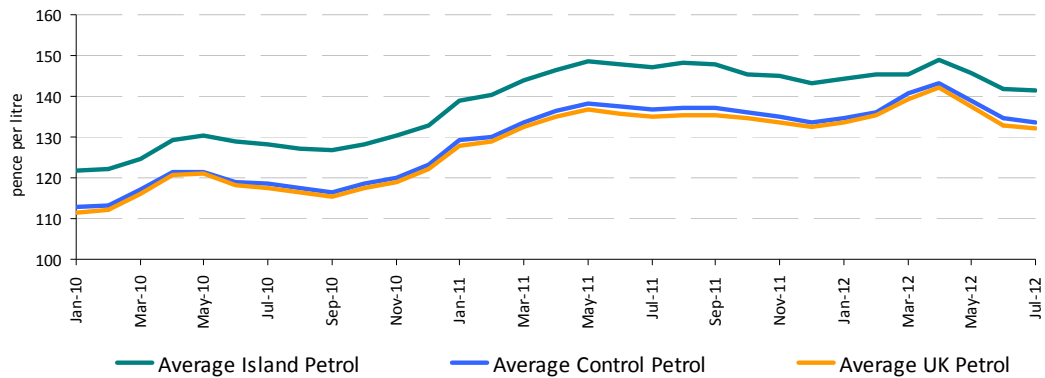
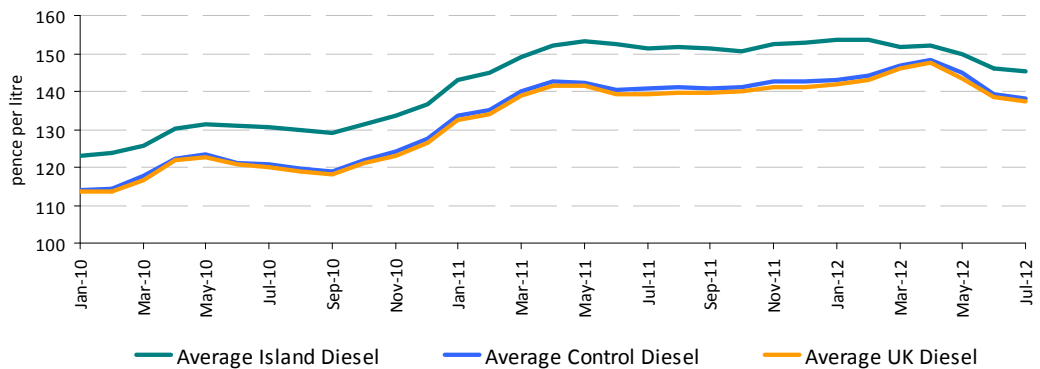
Map 2: Control Locations in Mainland UK



15. To confirm that this selection of towns is a valid control group for the islands in the scheme it is necessary to show that the trends of pump prices have been parallel in the months before the policy was introduced. Graphs 1 and 2 below show that the trend of prices for both fuels prior to January 2012 have behaved similarly. Further testing³ also demonstrates that the trends are parallel.
16. This control group was carefully selected to match the demographics of the areas in the scheme but competition in the UK road fuels sector works relatively effectively⁴ and UK average fuel prices also closely follow the same trend, as seen in Graphs 1.1 and 1.2 below.

³ Regression results testing the trends of the two series prior to March 2012 finds the trends to be parallel.

⁴ "UK Petrol and Diesel Sector, An OFT Call for Information", The Office of Fair Trading, January 2013.

Graph 1.1: Average Petrol Pump Prices In and Out of the Scheme

Graph 1.2: Average Diesel Pump Prices In and Out of the Scheme


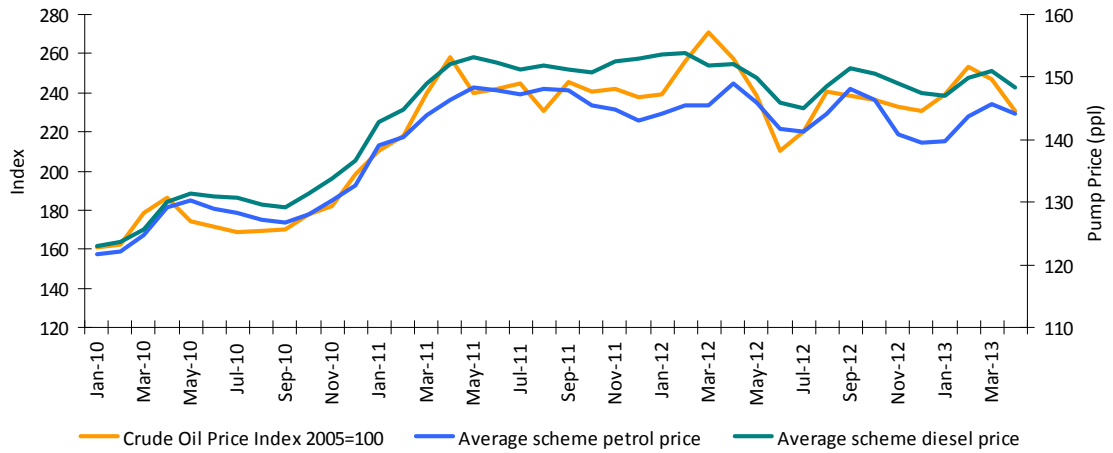
4. Review of the Data

17. Pump prices have been on an upward trend over time, mainly due to rising wholesale prices, but have levelled off slightly in the last year and look to be on a slight downward trend overall across the UK. The Experian Catalist data shows that petrol and diesel prices have broadly followed similar trends over recent years. The lowest monthly average prices in our dataset are 122ppl and 123ppl for petrol and diesel respectively, and the highest monthly average prices are 149ppl and 154ppl.

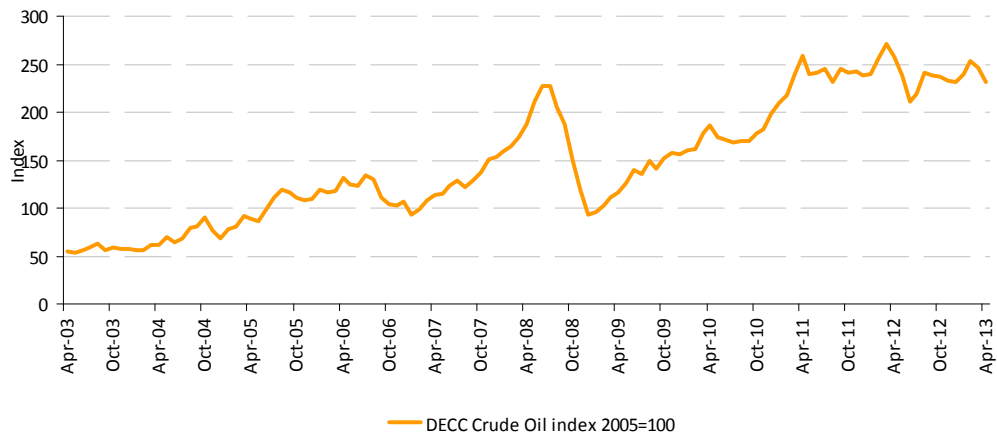
18. Pump prices for both fuel types closely follow the trend in crude oil prices, depicted in Graph 2. Although the trend of prices after the beginning of 2012 is flatter than the overall trend in previous years, this levelling actually looks to have started in 2011 due to an equivalent tapering of growth in crude oil prices. Looking at the long run trend of crude oil prices this is not unusual behaviour, as shown in Graph 3 below⁵.

⁵ Monthly crude oil index, Department of Energy & Climate Change, Data Table 4.1.1

Graph 2: Average Diesel and Petrol Pump Prices in the Scheme, Compared to a Sterling Crude Oil Index

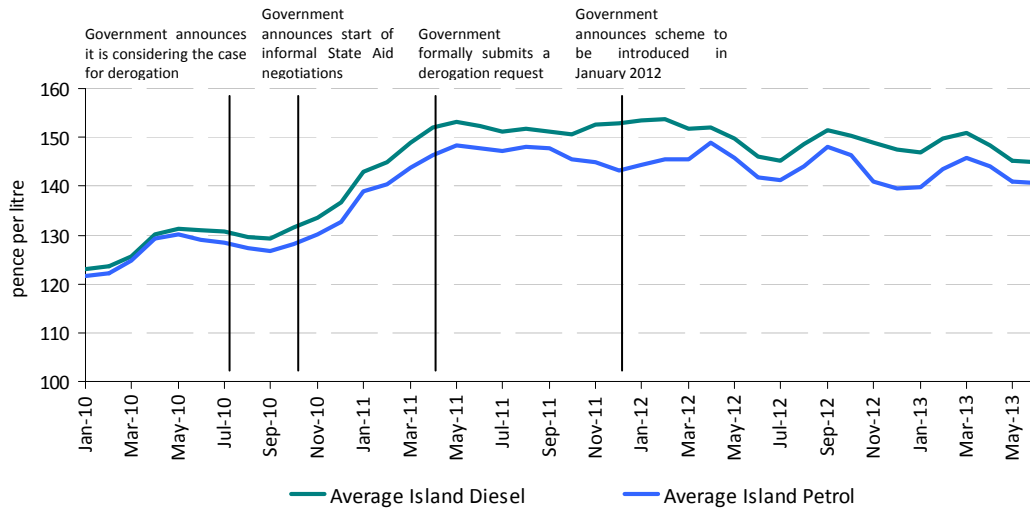


Graph 3: A Sterling Crude Oil Index over the last Ten Years



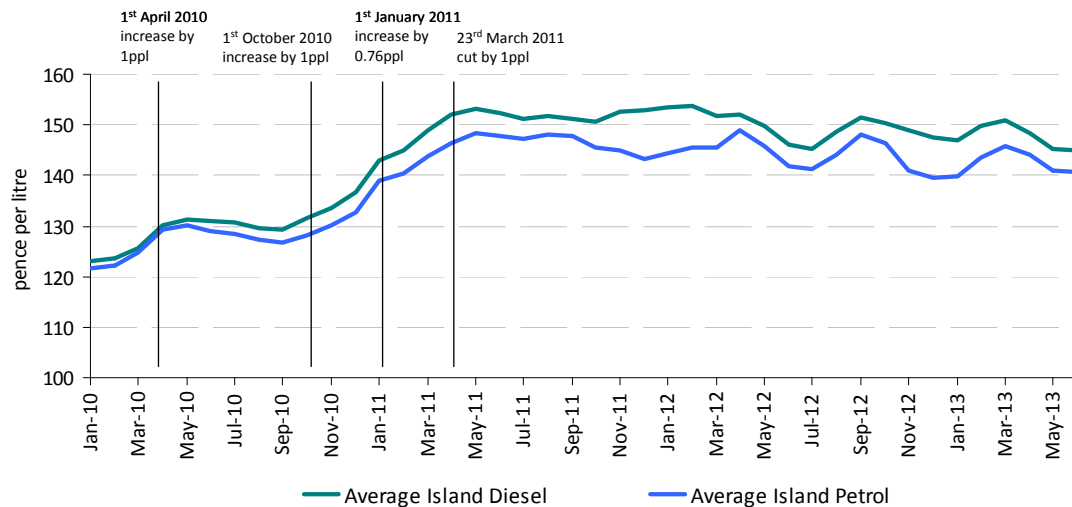
19. Looking specifically at the average island prices over time it appears that policy decisions and announcements in advance of the scheme have not had a noticeable effect on prices. The graph below shows the timing of various announcements related to the scheme.

Graph 4: Average Petrol and Diesel Pump Prices in the Scheme, with Policy Announcements



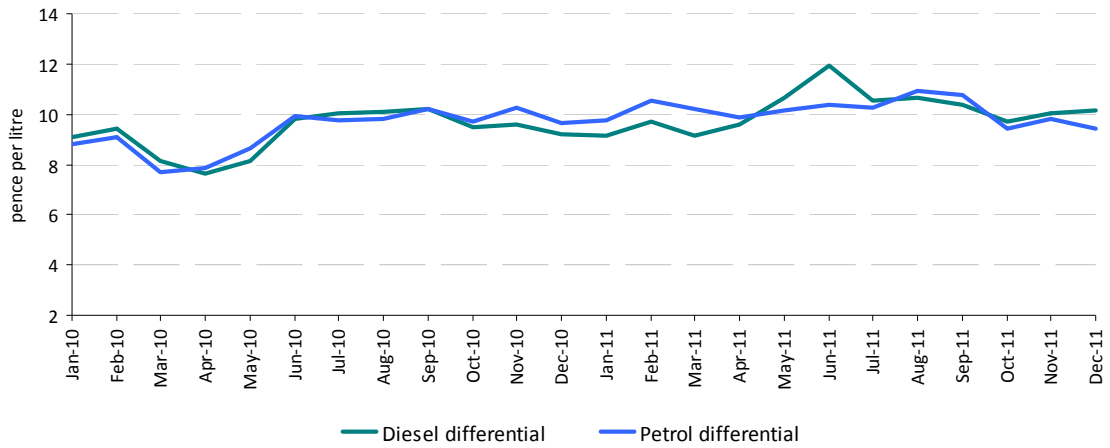
20. There have also been a series of fuel duty changes at the beginning of this period and these do not appear to affect the trend in pump prices or create volatility in the market, as shown by graph 5. The Government has made no changes to the rate of fuel duty since it was reduced in March 2011.

Graph 5: Average Petrol and Diesel Pump Prices in the Scheme, with Fuel Duty Changes



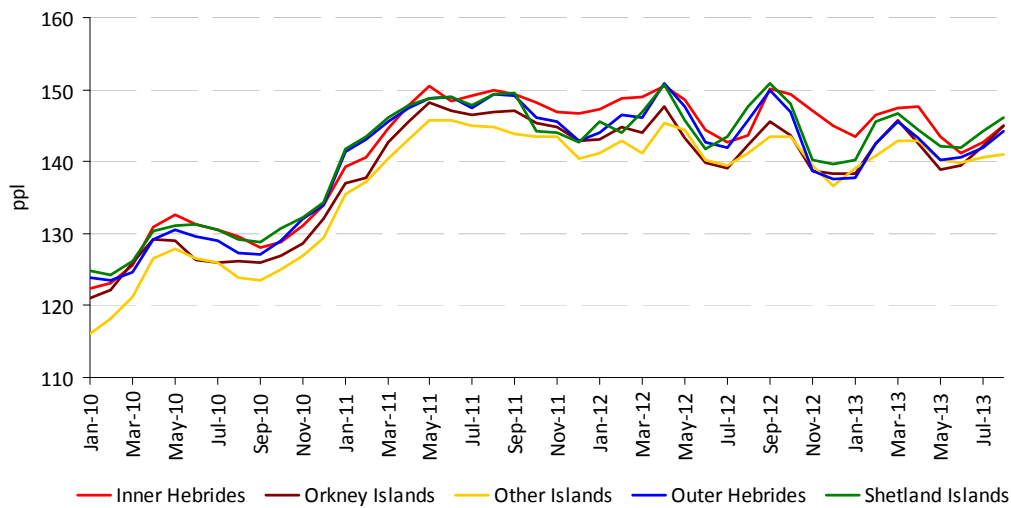
21. The pump prices on the islands were around 10ppl higher than the UK mainland prior to January 2012; between 8 - 13ppl higher than UK average and 8 - 12ppl higher than the control group selected. Graph 6 below shows that there has been some month-on-month variation in the differential, most likely because of varying throughput on the islands or lags in passing on oil price changes, but overall these variations are very small and the differential is reasonably flat over time.

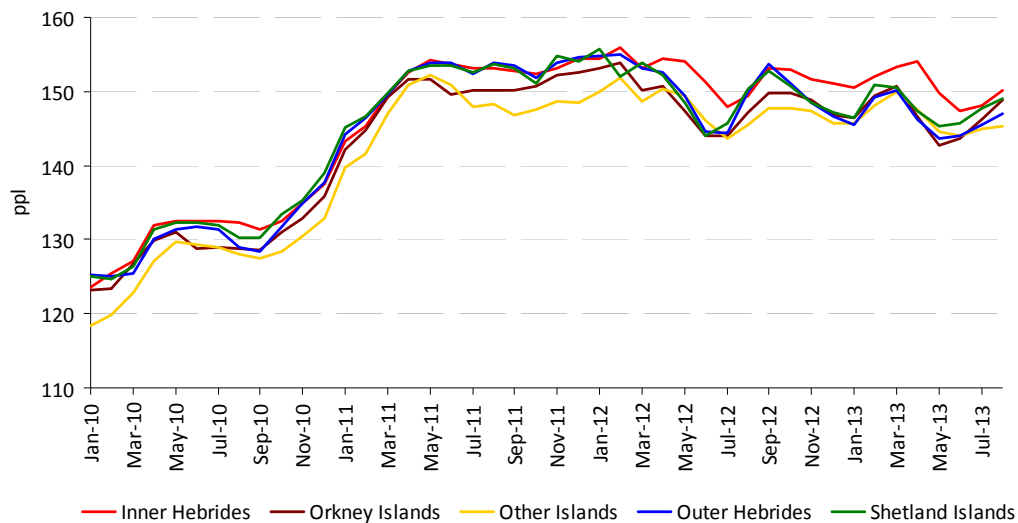
Graph 6: Difference in Average Petrol and Diesel Pump Prices between the Scheme and Control Group



22. The data also shows that pump prices vary by island group; average prices have varied by 2 - 9ppl between islands. The behaviour of prices has not been consistent over time, so those islands with the highest average price at the beginning of the period do not necessarily have the highest average price at the end, and this can be seen in Graphs 7.1 and 7.2 below.

Graph 7.1: Average Petrol Pump Prices on the Islands in the Scheme



Graph 7.2: Average Diesel Pump Prices on the Islands in the Scheme


23. Part of this variation could be due to the number of transactions made each month in each island group. The data used in this analysis is the monthly average price of all transactions made using the fuel card and these prices will therefore be affected by the frequency with which the fuel card is used. Table 1 below demonstrates the variation in the average number of transactions across the island groups.

Table 1: Average Number of Petrol and Diesel Transactions per Month per Island Groups

	Average Petrol Transactions	Minimum Transactions per Month	Maximum Transactions per Month	Average Diesel Transactions	Minimum Transactions per Month	Maximum Transactions per Month
Inner Hebrides	13	3	24	110	35	142
Orkney Islands	18	8	26	68	47	78
Other Islands	52	24	79	113	76	145
Outer Hebrides	70	26	102	137	85	175
Shetland Islands	67	15	93	114	88	147

24. As this table shows, the average number of transactions in each group varies considerably between islands and fuel types; there are many more diesel transactions than petrol. In addition the minimum and maximum number of transactions in any month in the dataset also varies widely, suggesting that there should be caution when relating the results of this evaluation to each island group.

5. Evaluation of the Policy

5.1 Competition Effects

25. A few of the control locations were chosen because they have ferry links to the islands in the scheme, in particular Thurso and Oban. These were selected so that the evaluation can consider whether there have been any competition effects; if the reduced duty on the islands is forcing competitors on the mainland to lower their prices we could expect to see a reduction in these coastal prices relative to the rest of the mainland. Additional coastal locations were selected that do not have links to the islands so that they could be a control group for the affected coastal towns.

Table 2: Towns Used to Measure Competition Effects

Treatment Towns	Control Towns
Thurso	Leven
Oban	Forres
Dunoon	
Fort William	

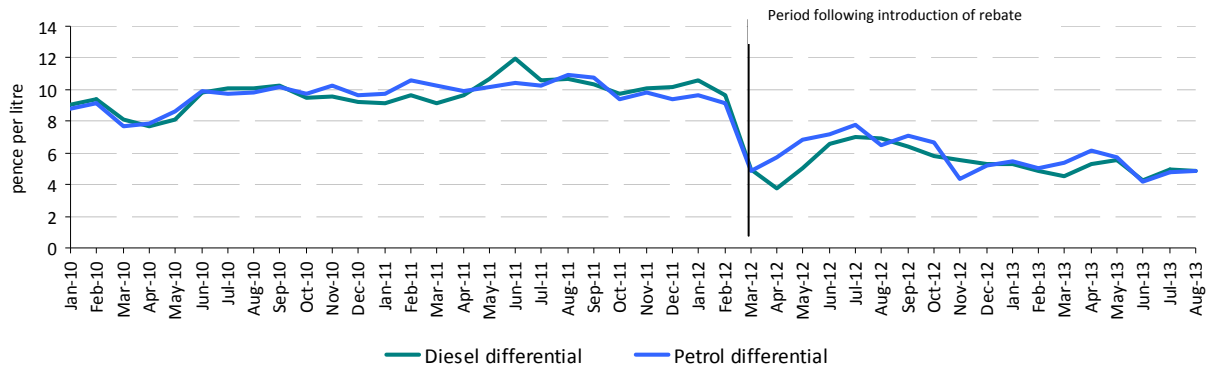
26. Difference in difference analysis was used to measure the impact of the scheme on these competing coastal locations and Annex B sets out the analysis undertaken. This concludes that there have been no obvious competition effects on the coastal mainland locations, and all locations outside of the scheme (coastal and inland) will be used as a comparison group for the main evaluation of pump prices on the islands.

5.2 Price Differential

27. The difference between the average scheme price and the average control price can provide information on the degree of implementation of the scheme, as this illustrates island price changes relative to prices on the mainland. If the control prices were affected by exactly the same factors as those affecting pump prices in the scheme, we could conclude that any change in the price differential in March 2012 was due to the introduction of the scheme. The control group for this evaluation was selected to match the characteristics of the towns in the scheme as closely as possible, which reduces the likelihood that other factors are affecting prices in both locations independently.

28. The graph below provides a clear depiction of the impact of the rural fuel duty relief.

Graph 8: The Average Fuel Price Differential between Locations In and Out of the Scheme



29. It is clear that the differential in prices in and out of the scheme has reduced following the introduction of the relief. Prior to March 2012 the average petrol prices on the islands were 9.68ppl higher (9.72ppl for diesel) than in the mainland locations, and following March 2012 they have been 5.76ppl higher on average (5.39ppl for diesel). As the table below demonstrates, the difference in the average differential is 3.92ppl for petrol and 4.33ppl for diesel.

Table 3: Average Petrol and Diesel Prices and Differentials

<i>ppl</i>	Before March 2012	After March 2012
Average petrol price on the islands	137.01	143.52
Average petrol price on the mainland locations	127.33	137.76
Differential	9.68	5.76

Change in Petrol Differential: 3.92

<i>ppl</i>	Before March 2012	After March 2012
Average diesel price on the islands	141.09	148.47
Average diesel price on the mainland locations	131.36	143.08
Differential	9.72	5.39

Change in Diesel Differential: 4.33

5.3 Take-up of the Scheme

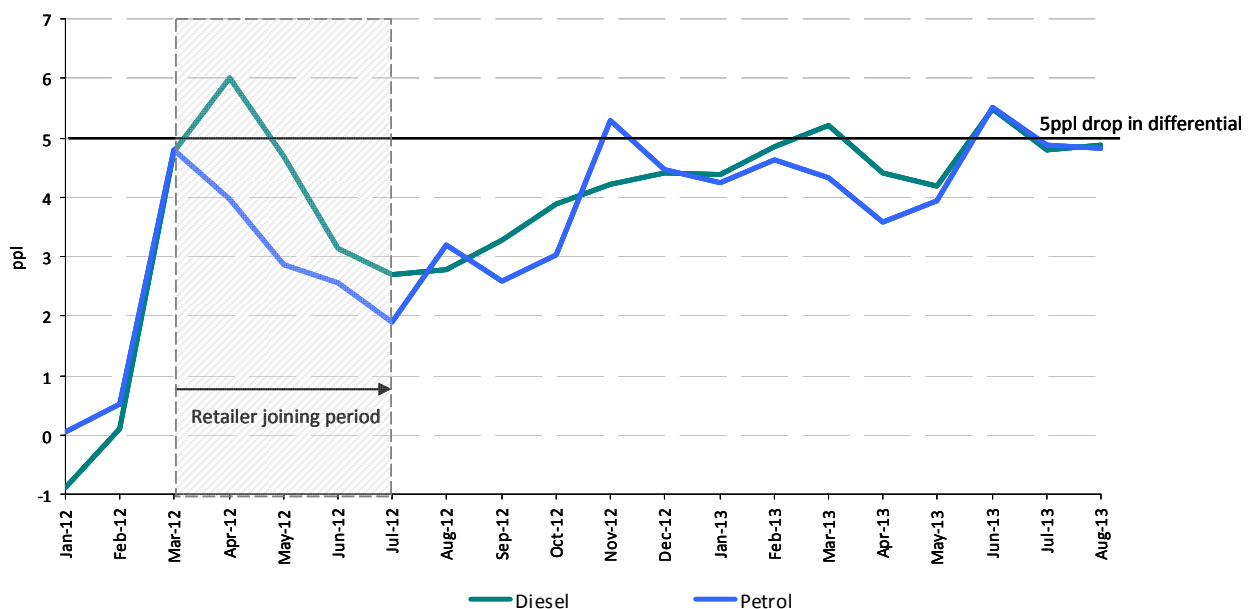
30. Retailers have been able to register for the scheme since January 2012, and have had 60 days from registration to reduce their pump prices. Retailers joining the scheme after January have also had 60 days to reduce the price they charge to motorists, so the rate at which pump prices on the islands have fallen will depend on the rate at which retailers have registered with HMRC for the scheme.
31. HMRC data shows that 79 retailers joined the scheme in January 2012 and a further 16 registered in February, but retailers were still joining gradually until May. These retailers will therefore not have had to reduce pump prices until July 2012. One retailer has joined the scheme in 2013, and it is possible that there are a few more retailers eligible for the scheme who have not yet joined (as Experian indicated there were 103 sites in eligible islands at one point).
32. There are a few possible reasons why retailers may have joined the scheme gradually over time. The relief is given to retailers based on the purchases of fuel they make (for retail sale) rather than on the quantity of fuel they sell to motorists. Any retailer that purchases fuel from refineries at infrequent points would therefore not have an incentive to join the scheme until they made their first eligible purchase of fuel. Across the UK it is expected that retailers will purchase fuel from a refinery very regularly, but in these remote islands where transport costs are increased it may be the case that purchases are made less frequently.
33. Additionally it is possible that retailers have become more aware of the scheme over time and have become more willing to join. It was expected that businesses would take up to 5 hours to familiarise themselves with the scheme and complete the registration process with HMRC, at a cost of less than £100 per business⁶, so the administrative burden of registering

⁶ Rural Fuel Duty Relief Tax Information & Impact Note, November 2011

for the scheme was not expected to be large but it may have taken retailers a few months to become aware of this.

34. The movement of the price differential between the islands and the mainland over time indicates that there may have been a period of behavioural adjustment taking place in the early months of the scheme as retailers joined. Graph 9 shows the monthly drop in the differential compared to the average differential in the years prior to the scheme. Prices in January and February 2012 were unchanged as retailers were not required to reduce their prices (i.e. the differential to the mainland was still around 10ppl). In the period between March and July 2012, when retailers were still joining the scheme, the price differential was variable; a sharp drop to 5ppl seen in the differential in March is inconsistent with the data that indicates only a proportion of retailers had joined the scheme by this point, and the April 2012 data for diesel shows a 6ppl fall relative to the mainland, which is greater than expected.

Graph 9: Reduction in Petrol and Diesel Differentials Compared to Before the Scheme



35. The majority of retailers had registered for the scheme by May 2012 so prices from July 2012 onwards should reflect more of the 5ppl relief. Graph 9 shows that the differential was not reduced by the full amount on average in July but it has increased each month since and looks to be settling around 5ppl.

36. It has not been possible to obtain data for each individual site in the scheme or control for the dates that each retailer has joined. The results of the difference in difference analysis in section four below therefore implicitly assume that all retailers joined the scheme in January and reduced their prices in March 2012. When drawing conclusions from the analysis it is therefore necessary to take the gradual take-up of the scheme into account.

5.4 Regression Results

5.4.1 Difference in Difference Analysis

37. Difference in difference regression analysis was run separately for both petrol and diesel fuels to establish the impact of the introduction of the relief on pump prices in the affected areas. The main results draw on a straightforward application of difference in difference without additional control variables, as the results of sensitivity testing found the main coefficients to be relatively insensitive to the variations of equation used. The straightforward approach provides the most intuitive interpretation of the policy effect and the regression equation used to conduct this is set out below.

$$price_{it} = \alpha + \beta_1 treated_i + \beta_2 implemented_t + \beta_3 imptreat_{it} + \varepsilon_{it} \quad [1]$$

Where *price* is the monthly average petrol or diesel price per location, *treated* is a dummy variable equal to 1 for scheme locations or 0 otherwise, *implemented* is a dummy variable equal to 1 in months from March 2012 onwards, and *imptreat* is an interaction of the *treated* and *implemented* variables.

38. The results of this regression analysis are listed in Table 4 below. The variable of particular interest in the interaction term *imptreat*, whose coefficient provides information on the change in price that is as a result of being in the affected scheme area after the introduction of the scheme.

Table 4.1: Petrol Difference in Difference Regression Results

Variable	Coefficient	P-value	95% confidence interval	
Constant	127.331	0.000	126.416	128.247
Treated	9.683	0.000	8.098	11.268
Implemented	10.426	0.000	8.995	11.857
ImpTreat	-3.918	0.002	-6.396	-1.440

Table 4.2: Diesel Difference in Difference Regression Results

Variable	Coefficient	P-value	95% confidence interval	
Constant	131.362	0.000	130.299	132.424
Treated	9.723	0.000	7.883	11.564
Implemented	11.719	0.000	10.058	13.380
ImpTreat	-4.334	0.003	-7.211	-1.457

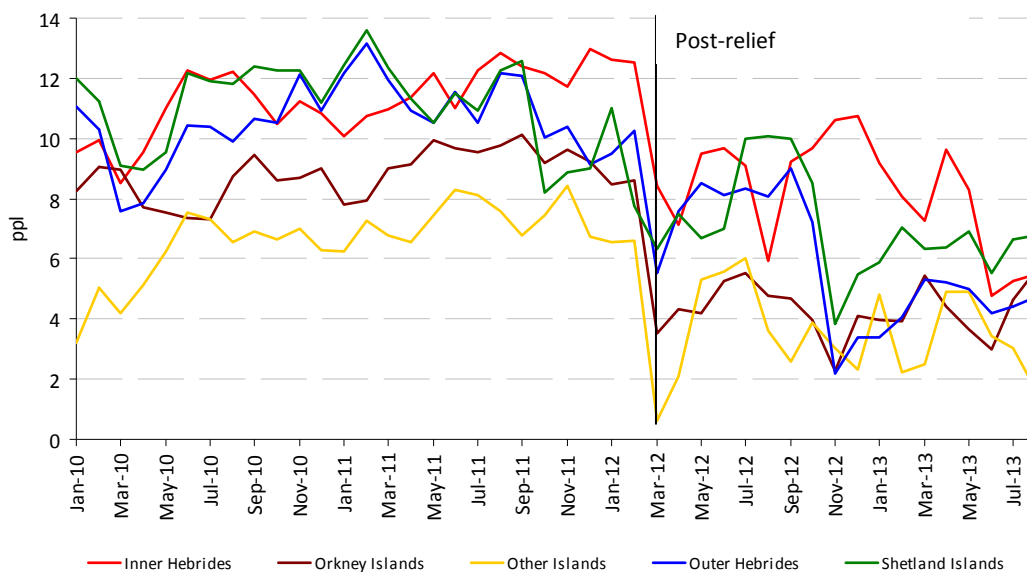
39. These results are straightforward to interpret. Prior to the policy introduction they show that the average pump price in the mainland control towns was 127ppl for petrol (131ppl for diesel) and the islands were 9.7ppl higher on average than the mainland before March 2012 for both fuels. Average petrol pump prices were expected to be 10.4ppl higher after March 2012 compared to before March 2012, if the policy had not been implemented (11.7ppl for diesel), but petrol pump prices on the islands are 3.9ppl (4.3ppl for diesel) lower on average compared to what their level would have been had the relief not been introduced.

40. However there is uncertainty around this estimate of the price reduction; the regression analysis gives a confidence interval around the average fall in the differential, which provides a range of values that describe the uncertainty. The 95 per cent confidence interval around the reduction in petrol prices is a 1.4 to 6.4ppl drop in the differential as a result of the policy. For diesel the 95 per cent confidence interval is a 1.5 to 7.2ppl drop. Further discussion of what this implies for the policy is covered in section six.
41. A number of approaches have been conducted to test the sensitivity of this regression, for example by including a crude oil index as an additional control variable⁷. Pump prices are directly correlated with crude oil prices so including this variable increased the explanatory power of the model but this did not substantially change the finding that petrol pump prices on the islands are almost 4ppl lower on average compared to what they would have been had the relief not been introduced, and diesel pump prices are just over 4ppl lower on average.

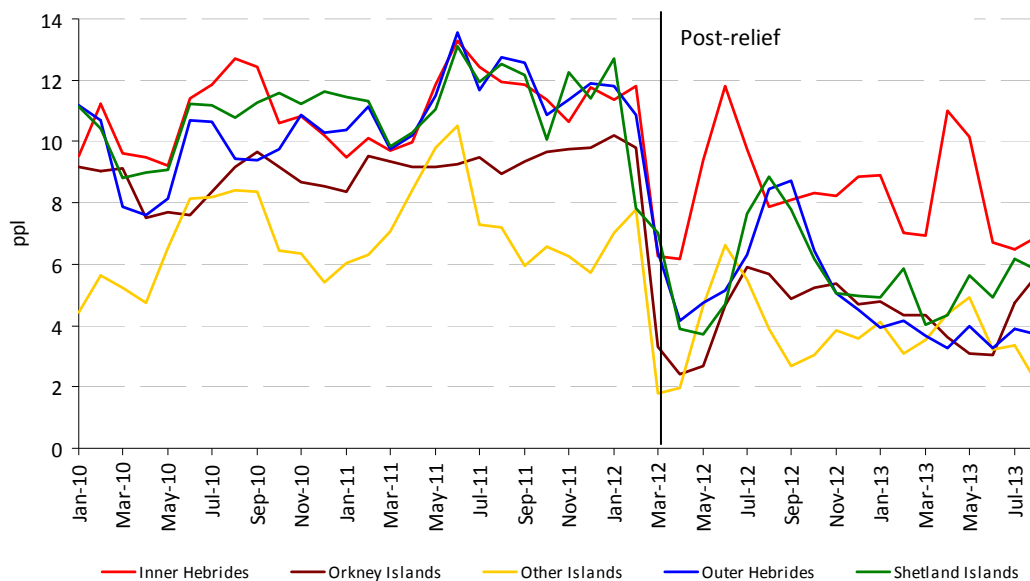
5.4.2 Individual Islands

42. The reduction of pump prices across individual islands has varied. Graphs 10.1 and 10.2 below show that the monthly differential between each island group and the control towns has been volatile over the last three years, but there is a clear drop in the differential after March 2012 compared to before the scheme and the differential has stayed lower on average since.

Graph 10.1: The Average Petrol Price Differential in Island Groups



⁷ Additional tests included adding dummy variables to capture island variation, including a dummy variable to capture a period of behavioural ‘settlement’ in the months immediately after the policy introduction, and testing whether setting January 2012 or February 2012 as ‘implementation month’ changed the results. The coefficient of interest was not particularly sensitive to any of these approaches.

Graph 10.2: The Average Diesel Price Differential in Island Groups


43. One reason for the variation across the islands seen in these graphs is likely to be that the number of transactions recorded each month has varied. The review of the data in section 4 of this paper showed that the number of transactions in each month in each location has fluctuated widely and this could indicate that the prices recorded by the fuel card may not be representative of the all the prices charged to consumers in every location.
44. It is also possible that larger islands with more stations experience greater price competition and therefore compete to offer the lowest fuel price. The price reduction in each island may therefore reflect the degree of competition on the island.
45. To explore this further Table 5 below demonstrates the link between the average drop in the differential per island, the average number of transactions made each month, the approximate number of stations in each island group⁸, and the total population of each island⁹. It can be seen that the Shetland Islands, Orkney Islands and Outer Hebrides are of a similar size, whereas the Inner Hebrides and Other Islands are notably smaller.

Table 5: The Population, Number of Stations & Transactions and Drop in Differential in the Islands

	Island Population	Number of transactions		Average drop in differential (ppl)		Approximate Number of Stations
		Petrol	Diesel	Petrol	Diesel	
Outer Hebrides	19,900	70	137	4.79	5.66	20
Shetland Islands	17,600	67	114	4.00	5.33	25
Orkney Islands	15,300	18	68	4.50	4.70	25
Other Islands	5,100	52	113	3.18	3.22	15
Inner Hebrides	3,500	13	110	3.13	2.76	20

⁸ Source: Experian Catalist

⁹ Source: 2001 Scottish Census

46. Generally the larger islands have more stations and a larger drop in the average differential, but surprisingly the number of transactions made using the fuel card is not directly correlated with the island population or number of stations (in particular for the Orkney Islands). This implies that either the Experian fuel card does not capture an equal proportion of transactions in each island or that the number of transactions per station varies across island groups and competition may therefore differ.
47. The trends shown by this data therefore indicate that analysis at an individual island level should be treated with a large degree of uncertainty as there is not enough information to accurately compare the reduction in the differentials.

6. Uncertainty Surrounding the Results

6.1 Methodological Uncertainty

48. There are a number of reasons why there is uncertainty over the effect of the scheme, and this might explain why this analysis has found an average reduction in price following March 2012 that is lower than the 5ppl expected. These are summarised below.
49. There has been a gradual take-up of this scheme that the data analysis has not been able to take into account, so the average price reduction over the whole period since March 2012 is capturing prices charged on the islands by retailers both in and out of the scheme at some points. This is especially the case at the beginning of the 'post-policy' period and is backed up by the data that shows that more recent months have seen a larger reduction in prices relative to the mainland.
50. In addition to the gradual take-up of the scheme it is possible that there are a few retailers in eligible areas that have not registered for the scheme to date and the prices of these retailers will be included in the data used for this evaluation. The average price in the scheme areas may therefore be calculated using some retailers that are not required to reduce their prices and this will make the overall price reduction shown by the data smaller than 5ppl.
51. Furthermore the difference in difference analysis implicitly controls for movements in the underlying oil prices that are common to both the islands and the mainland. If there has been a change in the costs on the islands but not the mainland, or if any other factors have affected only one set of locations (e.g. increased ferry prices), this will affect the size of the price reduction seen in the data and mask the true impact of the policy. In this instance a retailer may have reduced their pump prices by the full 5ppl but it may not show as such in this data.
52. Due to the rural nature of the locations in the scheme the number of fuel purchases made can be as low as 3 per month. Where the average price is calculated from such a small number of observations this increases the uncertainty surrounding the results and it may mean that the average reduction in the differential seen in the data is less than the true reduction made by retailers in the scheme.
53. The 'average' price that is used to calculate the differential between the islands and the mainland is calculated as an arithmetic mean and is not weighted by the number of transactions made in each island group. This is so that it captures the prices charged at each location with equal weight and reflects the effect of the scheme at an aggregate level. Earlier discussion around the lack of correlation between the number of stations and the

number of transactions recorded for each island group shows that there is uncertainty around whether the number of transactions made using the fuel card is proportional to the total number of transactions. If the use is not proportional, for example if the fuel card is used much more on only a few islands, then using a weighted average would incorrectly skew our data towards islands that use the fuel card more.

54. Confidence intervals in regression analysis are one way to represent how "good" an estimate is; the larger a 95 per cent confidence interval for a particular estimate, the more caution is required when using it. The confidence intervals around the estimate of the price reduction indicate that, if we were to repeatedly make new estimates using samples of pump prices on the islands, the confidence intervals would contain the average of all the estimates 95 per cent of the time. The intervals given for each of the petrol and diesel regressions are quite wide, reflecting the small sample size available for some islands and the variability in the prices between islands and over time. These wide confidence intervals (around a 1 to 7ppl drop in the differential) create uncertainty over the true reduction in the differential on the islands.

6.2 Island Uncertainty

55. There is a reasonable amount of variation in the impact of the scheme amongst the islands groups which could be due to a number of factors. The number of retailers in each island group varies from around 15 to 25 and resulting levels of competition may influence the movement of prices. Additionally the quality of the data from the fuel card may vary by island or there may be factors affecting the cost structure of each individual island that cannot be captured by this data analysis and would lead to varying price differentials between the islands. Finally the stations on these islands have been able to join the scheme gradually since January 2012 and the rate at which they joined may have impacted the average reduction in prices shown by the data.

7. Conclusion

56. This evaluation of the rural fuel duty relief finds that the scheme has successfully reduced prices on the islands relative to the UK mainland. Pump prices for petrol and diesel fell relative to the mainland in March 2012 as a result of the introduction of the scheme and they have remained lower in all months since.
57. Difference in difference analysis finds that prices are around 4ppl lower on average across all the islands compared to the mainland control locations, over the period since March 2012. However there is uncertainty around this estimate of the price reduction; the evaluation finds that prices were between 1.5 – 7ppl lower¹⁰ with 95% confidence. The analysis shows that there is variation by fuel type; pump prices were on average 3.9ppl lower for petrol and 4.3ppl for diesel relative to the mainland, which could reflect the better quality of data collected for diesel purchases. The data also shows a varying effect of the scheme at an island level but there is a large degree of uncertainty surrounding this level of detail and we are not able to draw conclusions on individual islands.
58. Average data following March 2012 therefore indicates that prices have reduced by 78 per cent (for petrol) and 87 per cent (for diesel) of the 5ppl reduction expected. However there is evidence that the take-up of the scheme has been gradual so this average reduction in prices includes retailers both in and out of the scheme, especially in early months. The price

¹⁰ 1.4 to 6.4ppl lower for petrol and 1.5 to 7.2ppl lower for diesel.

differential between the islands and the mainland has changed over time and more recent months have seen a larger reduction in the island prices.

59. Prices on the islands were on average 5ppl lower in the latest quarter of data¹¹ than before the introduction of the scheme, relative to the UK mainland. Given this, we consider the scheme to be effectively reducing prices on aggregate and that the evaluation is complete.
60. These results therefore provide strong evidence that the policy is meeting its objective of reducing the pump prices faced by motorists in the scheme. Following initial unsettled price behaviour, the differential has reduced over time as more retailers have joined and we might expect a greater average pass-through in future months. Additionally, methodological uncertainty means that the average reduction in the price differential found in the data may be lower than the actual level of price reduction passed on by retailers.

¹¹ June 2013 to August 2013 at the time of drafting

Annex A: List of Islands in Island Groups Accepting Fuel Card

Island Group	Island Name
Inner Hebrides	Coll
	Colonsay
	Gigha
	Islay
	Jura
	Mull
	Tiree
	Seil
Outer Hebrides	Barra
	Benbecula
	Harris and Lewis
	North Uist
	South Uist
Orkney Islands	Eday
	Flotta
	Hoy
	Papa Westray
	Rousay
	Sanday
	Shapinsay
	South Walls
	Stroma
	Stronsay
	Westray
Shetland Islands	Bressay
	Unst
	Whalsay
	Yell
Other Islands	Arran
	Bute

Annex B: Measuring Competition Effects

61. A few of the control locations were selected so that the evaluation can consider whether there have been any competition effects. The towns used to measure competition effects are listed below.

Table 2: Towns Used to Measure Competition Effects

Treatment Towns	Control Towns
Thurso	Leven
Oban	Forres
Dunoon	
Fort William	

62. Difference in difference regression analysis using these locations indicates whether there is a significant difference in the trend of prices across competing towns and other coastal locations following the introduction of the scheme. The following regression was run to evaluate this.

$$price_{it} = \alpha + \beta_1 treated_i + \beta_2 implemented_t + \beta_3 impreat_{it} + \varepsilon_{it} \quad [2]$$

Where *price* is the average petrol or diesel pump price in each month for each location in Table 2, *treated* is a dummy variable to capture whether the location had links to the islands, *implemented* is a dummy variable to capture the time periods after March 2012, and *impreat* is an interaction of the two dummy variables.

63. The results of this regression can be found below. The coefficient of interest is the coefficient on the interaction variable *impreat*; this provides the effect on pump prices of being in the treatment group after the relief was implemented. The results of this regression show that the coastal locations with links to the islands were around 2ppl more expensive than the other coastal locations, but that there was no significant reduction in their prices relative to the control group following the introduction of the policy.

Table 6.1: Petrol Difference in Difference Competition Regression Results

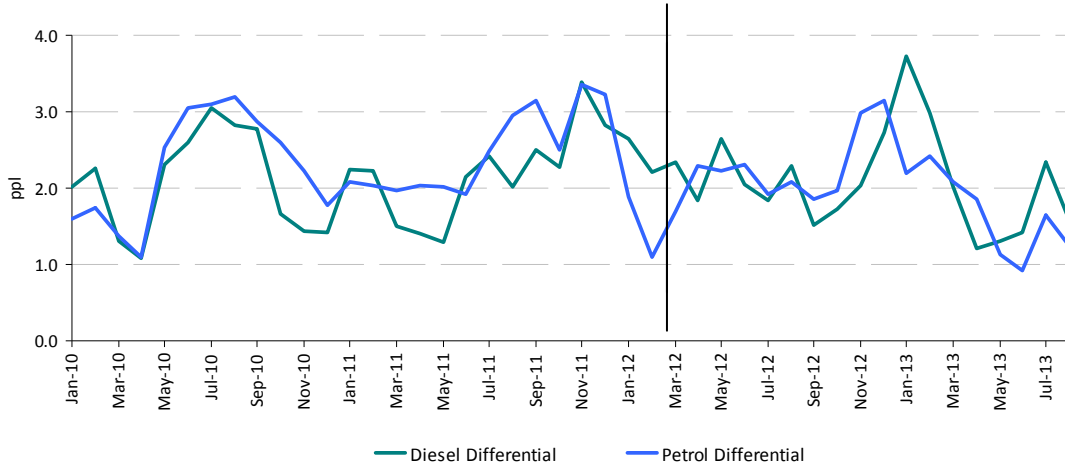
Variable	Coefficient	P-value	95% confidence interval	
Constant	126.035	0.000	123.988	128.083
Treated	2.303	0.072	-0.205	4.810
Implemented	10.732	0.000	7.531	13.933
ImpTreat	-0.308	0.877	-4.228	3.612

Table 6.2: Diesel Difference in Difference Competition Regression Results

Variable	Coefficient	P-value	95% confidence interval	
Constant	130.289	0.000	127.898	132.680
Treated	2.146	0.150	-0.782	5.075
Implemented	11.757	0.000	8.018	15.495
ImpTreat	-0.058	0.980	-4.637	4.520

64. Furthermore, graphing the difference between average pump prices in the coastal treatment towns and coastal control towns also demonstrates that there is no noticeable change following the introduction of the scheme, as shown in Graph 11 below.

Graph 11: The Petrol and Diesel Differential between Treatment and Control Coastal Towns



Annex C: The Selection of Control Towns in Mainland UK

65. All the islands off the coast of Scotland benefit from the relief, so the control locations had to be located in the mainland. Towns have been selected in mainland Scotland that exhibit similar relevant characteristics to the main town in each of the island groups in the scheme. The particular characteristics that are important for this evaluation are:

- Population
- Car ownership among households
- Car usage - travel to work
- Location - whether inland or coastal
- Proximity to large towns/cities

66. The Highlands of Scotland display similar remote characteristics to the Scottish islands, but the population of settlements in this location are not large enough to generate sufficient data points to form a control group. The control towns chosen therefore are located across all of Scotland, and are listed below.

- | | |
|-----------|----------------|
| ▪ Keith | ▪ Dunoon |
| ▪ Turriff | ▪ Leven |
| ▪ Kelso | ▪ Fort William |
| ▪ Thurso | ▪ Forres |
| ▪ Oban | ▪ Blairgowrie |

67. The tables below summarise the characteristics of the main town on the island groups and the control towns¹². These control locations were chosen because their total population is within the range found on the main town in each island group. The proportion of households that own a car is within 60 to 70 per cent and the proportion of people that use a car to drive to work is within 50 to 70 per cent, in line with the reliance on cars on the islands.

Table 7: Relevant Characteristics of the Main Town in each Island Group

	Shetland Islands	Orkney Islands	Inner Hebrides	Outer Hebrides	Other Islands
Main Island	Mainland Shetland	Mainland Orkney	Islay	Lewis and Harris	Arran
Island Population	17,600	15,300	3,500	19,900	5,100
Main Town	Lerwick	Kirkwall	Bowmore	Stornoway	Brodick
Town Population	6,800	6,200	900	5,600	600
% of households that own a car	65%	66%	65%	59%	77%
% of people that drive to work	65%	55%	51%	60%	50%

¹² Data taken from the 2001 Scottish census, the data available at the time of analysis.

Table 8: Relevant Characteristics of each Control Town

	Oban	Dunoon	Thurso	Leven	Fort William	Forres
Town Population	8,100	8,300	900	8,100	9,900	9,000
Location	Coastal	Coastal	Coastal	Coastal	Coastal	Coastal
% of households that own a car	63%	60%	67%	65%	67%	72%
% of people that drive to work	55%	60%	63%	69%	62%	66%

	Keith	Turriff	Kelso	Blairgowrie
Town Population	4,500	4,500	5,700	8,000
Location	Inland	Inland	Inland	Inland
% of households that own a car	71%	74%	72%	74%
% of people that drive to work	61%	62%	65%	68%