

The Distributional Impacts of Transport-related Carbon Policy

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Disclaimer

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- These **results are not official statistics**. They have been created for research purposes from the Integrated Data Infrastructure (IDI) which is carefully managed by Stats NZ. For more information about the IDI and LBD please visit <https://www.stats.govt.nz/integrated-data/>.

Project Objectives

- To better understand ...
 - potential distributional impacts of transport-related carbon policies
 - relationship between transport costs, housing costs, and access to jobs/opportunities/services for different groups
- Methods
 - Literature review
 - Analysis of transport expenditures for different income groups

Carbon Pricing Policies

- Deemed “indispensable” to **efficiently** mitigate carbon emissions
 - High-Level Commission on Carbon Prices (2017)
 - Adjusts pricing to better reflect negative effects of carbon emissions → **efficient**
 - People plan spending based on current prices – price changes require adjustment
- Common arguments against carbon policies
 - Greater burden on lower income households
 - Negative effects on jobs, businesses, and GDP
- Economic impacts could be disproportionately distributed across the population
 - Households
 - Workers
 - Businesses

Previous Research on Distributional Impacts

- Large literature on impacts of carbon pricing
 - Households (HH)
 - Energy bills
 - Transport costs
 - Incomes
 - Workers/businesses
- For HH, focus generally on effects of fuel taxes/subsidies on different income groups
 - Regressive – disproportionate burden on low-income households
 - Neutral or proportional – equal burden across all income groups
 - Progressive – disproportionate burden on high-income households
- Less focus on non-price interventions
 - Fuel-efficiency (CAFE) standards

Related Literature

- Equity and accessibility in transport options
 - Spatial mismatch hypothesis (1968) – jobs available for low-income, minority households but not near their homes
 - Early focus on minority, low-income, inner-city households unable to reach available suburban jobs
 - More recent research
 - Focus on broader groups (e.g., women, older adults, ethnic minorities)
 - Sustainable transport options (e.g., cycling infrastructure)
- NZ literature
 - Mattingly & Morrissey (2014)
 - Housing costs decline away from Auckland centre but transport costs increase
 - Changes “housing affordability” analysis if include both with peripheral areas costing 5x’s more
 - Xiong et al. (2021) key workers (constrained by budget) in Auckland had longest commutes

Key Findings from DI Literature

- **Well-designed** carbon policies can be consistent with growth, development, and poverty reduction
- Carbon taxes tend to be regressive in *developed countries*
 - Fixed costs of household energy – especially electricity due to appliances
 - Transport fuel taxes tend to be progressive even in developed countries
- Policy design can affect effectiveness and distributional outcome
 - Measures to offset negative distributional effects (e.g., revenue recycling) can flip regressive policy to progressive
 - Method of recycling/offsetting matters
 - Lump sum transfers, flat-tax discounts, food subsidies lean progressive
 - Corporate or income-based tax discounts tend to have no effect
 - Non-price interventions combined with price interventions


More nuanced policy approach ...

“will require a greater understanding of the structure of the economy and of the distributive effects of policies than an approach that relies simply on carbon taxes.”

~Joseph Stiglitz, Nobel Laureate

Stiglitz, J. E. (2019). *Addressing Climate Change through Price and Non-Price Interventions* (Working Paper No. 25939; Working Paper Series). National Bureau of Economic Research.

<https://doi.org/10.3386/w25939>



Public Support of Policies

- French Yellow Vest Protests in 2018
 - Recent (not unique) resistance to carbon taxes
 - Issues
 - Increasing fuel prices + additional fee on diesel
 - After reduction in tax on wealthiest
 - No clear earmarking of tax revenues – seen as offset for tax cuts for the wealthy
 - Reduction in speed limit on rural roads – citations viewed as additional tax
 - Protesters disproportionately rural and peri-urban
 - Rely heavily on private vehicles
 - Research analysing protesters' views found common themes
 - Unfair policy placing burden on unprivileged
 - No evidence of climate denialism/scepticism
 - Fuel tax initially suspended but then dropped – not reinstituted

Expenditure Analysis

- Household Economic Survey (HES)
 - Expenditure component every 3 years
 - July-June
 - 2006/07 to 2018/19 (5 survey years)
 - Transport Module
 - Large expenditures (car purchases) – 12-month look-back
 - Regular expenditures (insurance) – last bill
 - Small day-to-day expenditures – Diary (14 days until 2018/19)
- Distance measures from © OpenStreetMap
 - From HH residence to closest TA/Auckland Ward seat
 - Car travelling distance in minutes and kilometres

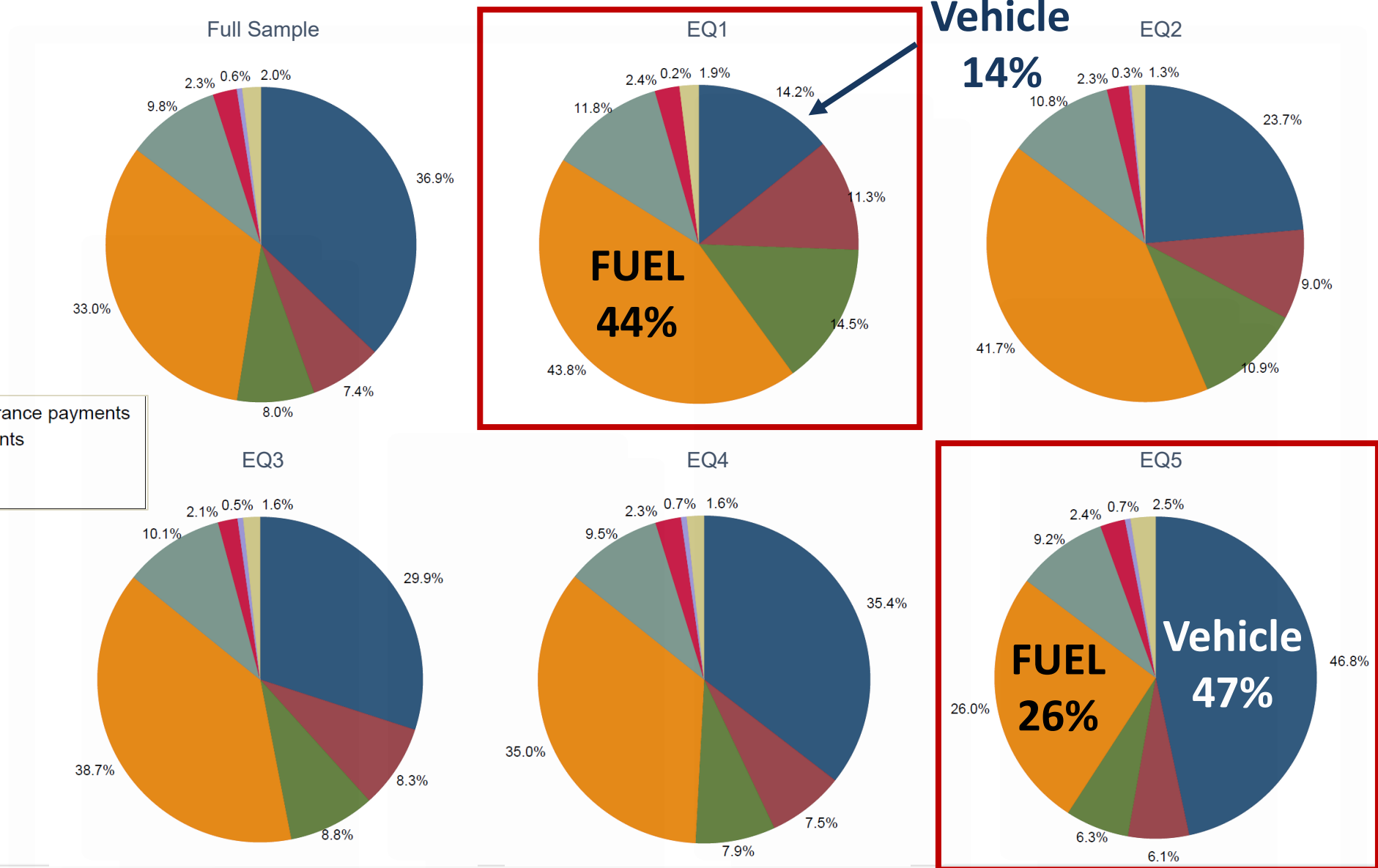
Study Design Matters for Policy Outcomes

- Lit Review indicates that study design can affect policy's regressive/progressive outcome
 - Included measures (e.g., health benefits of reduced emissions)
 - Proxy for lifetime income
 - Annual income vs. annual expenditure
 - Inclusion of all households (zero vs. non-zero expenditures)
- Our results generally based on ...
 - annual expenditure
 - inclusion of all households

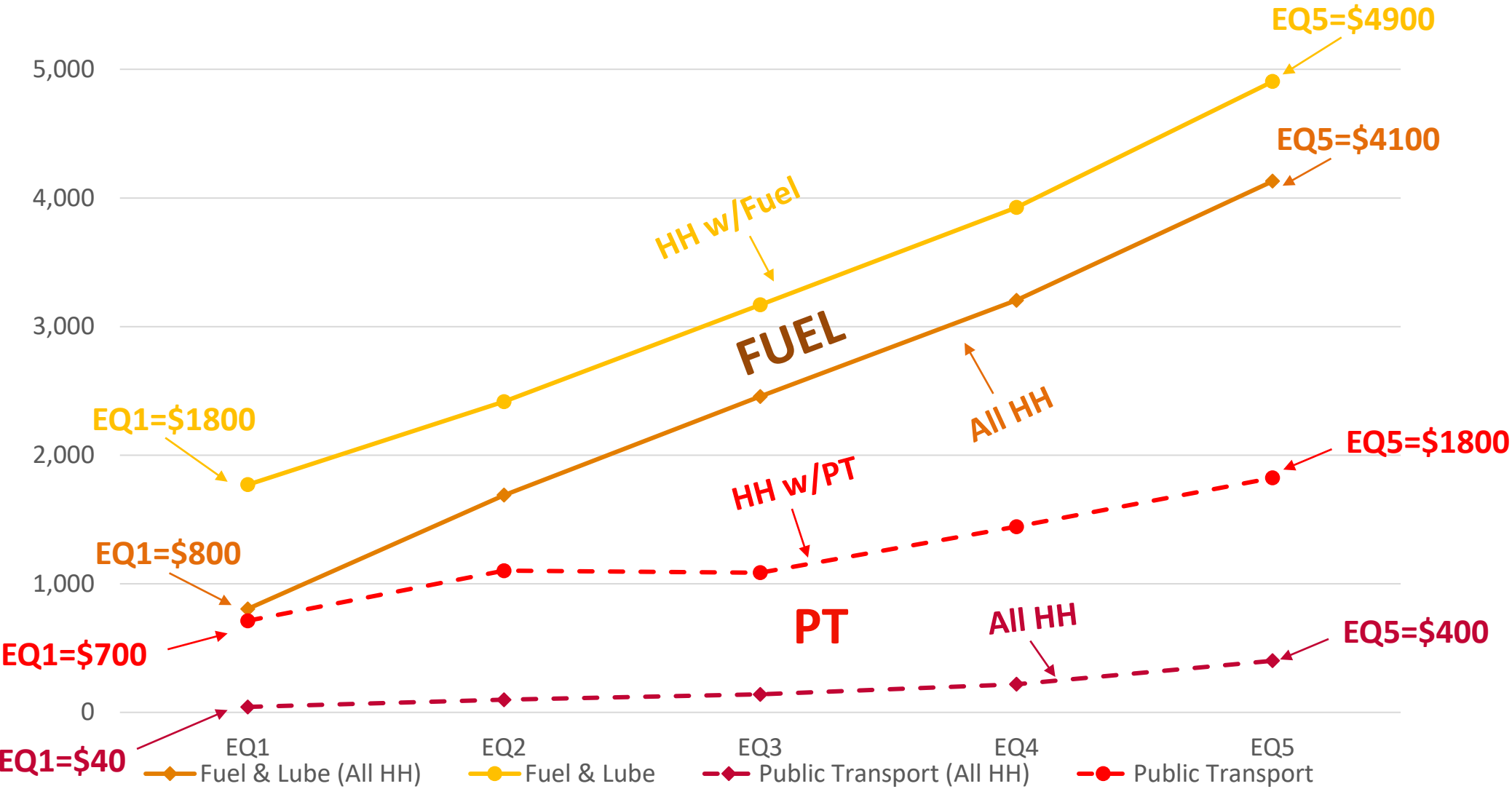
Methods

- Descriptive Analysis
 - Income groups – expenditure quintiles
 - Households with at least one retiree
 - Urban/Rural
- Regression Analysis
 - Logistic regression
 - Assess factors affecting likelihood of household reporting expenditure (e.g., fuel, public transport)
 - Dependent variable is binary (e.g., households report fuel expenditures (1) or not (0))
 - Linear regression
 - Assess factors affecting size of expenditure
 - Dependent variables
 - Levels (zero and non-zero)
 - Logs (non-zero)
 - Share of total expenditure
 - Samples
 - All households
 - Low-income households (bottom 2 expenditure quintiles)

Share of **Transport** Expenditures By Type and Quintile

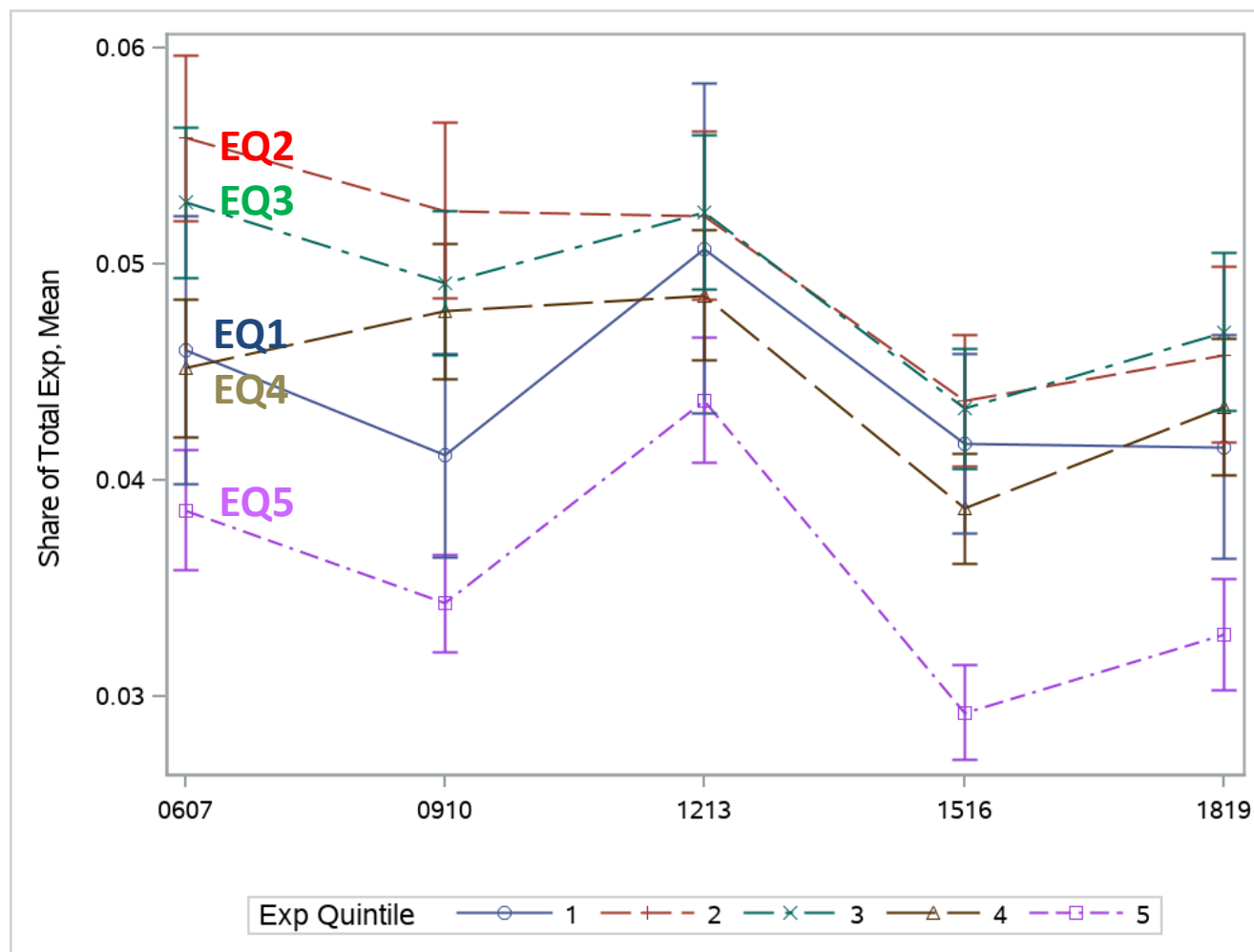


Annual Expenditures Increase by Quintile

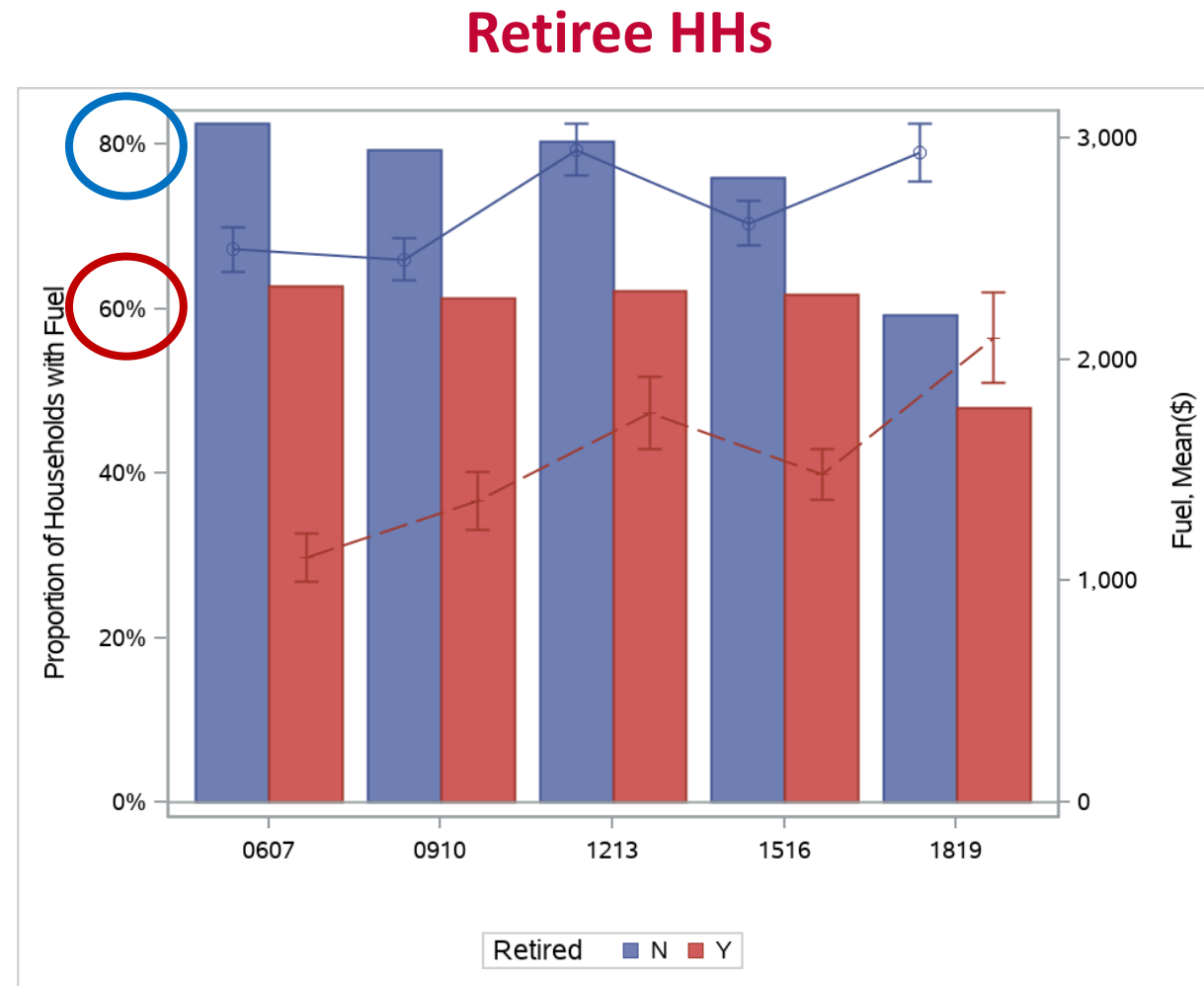
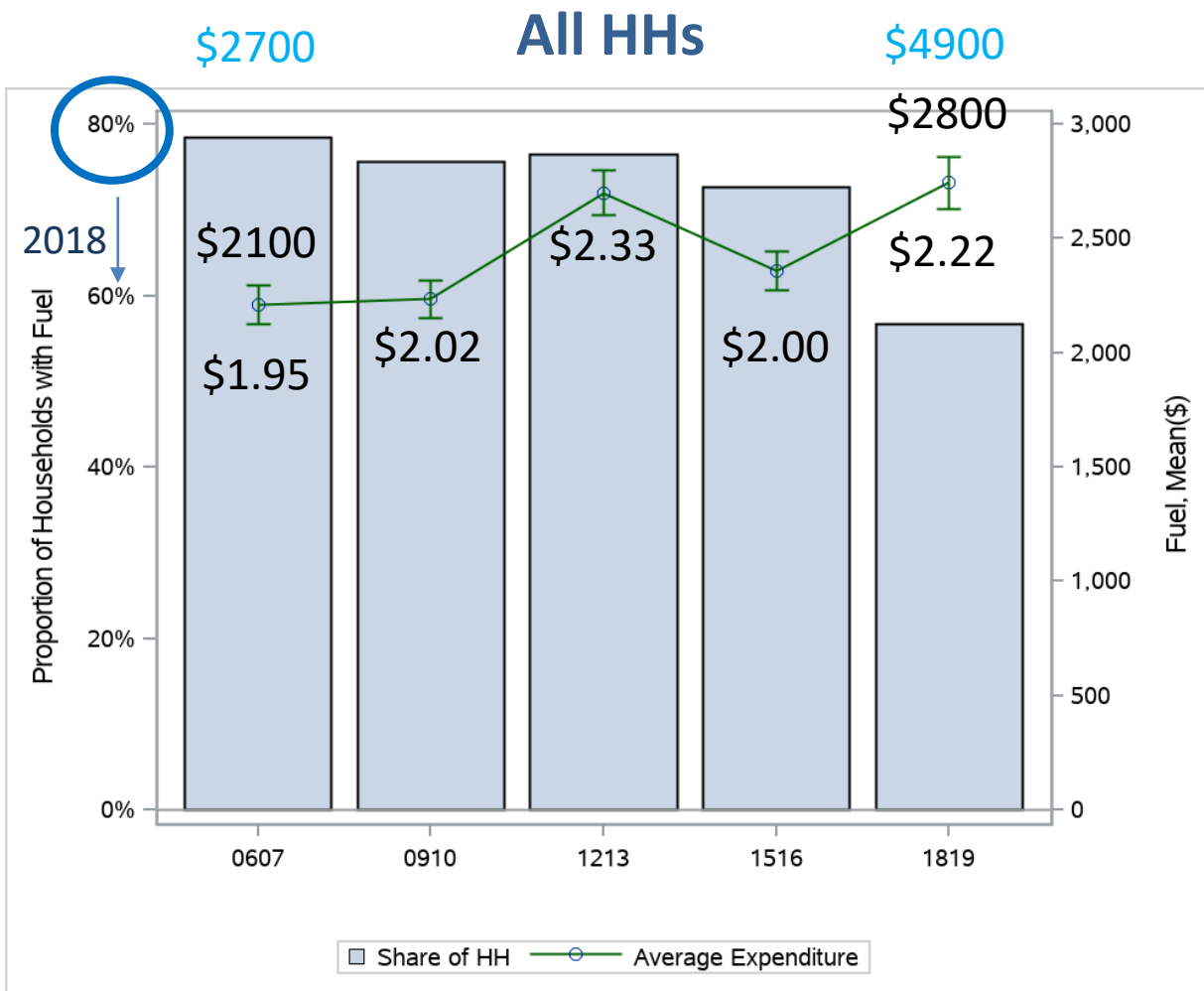


Fuel Share of Total Expenditure Decreasing

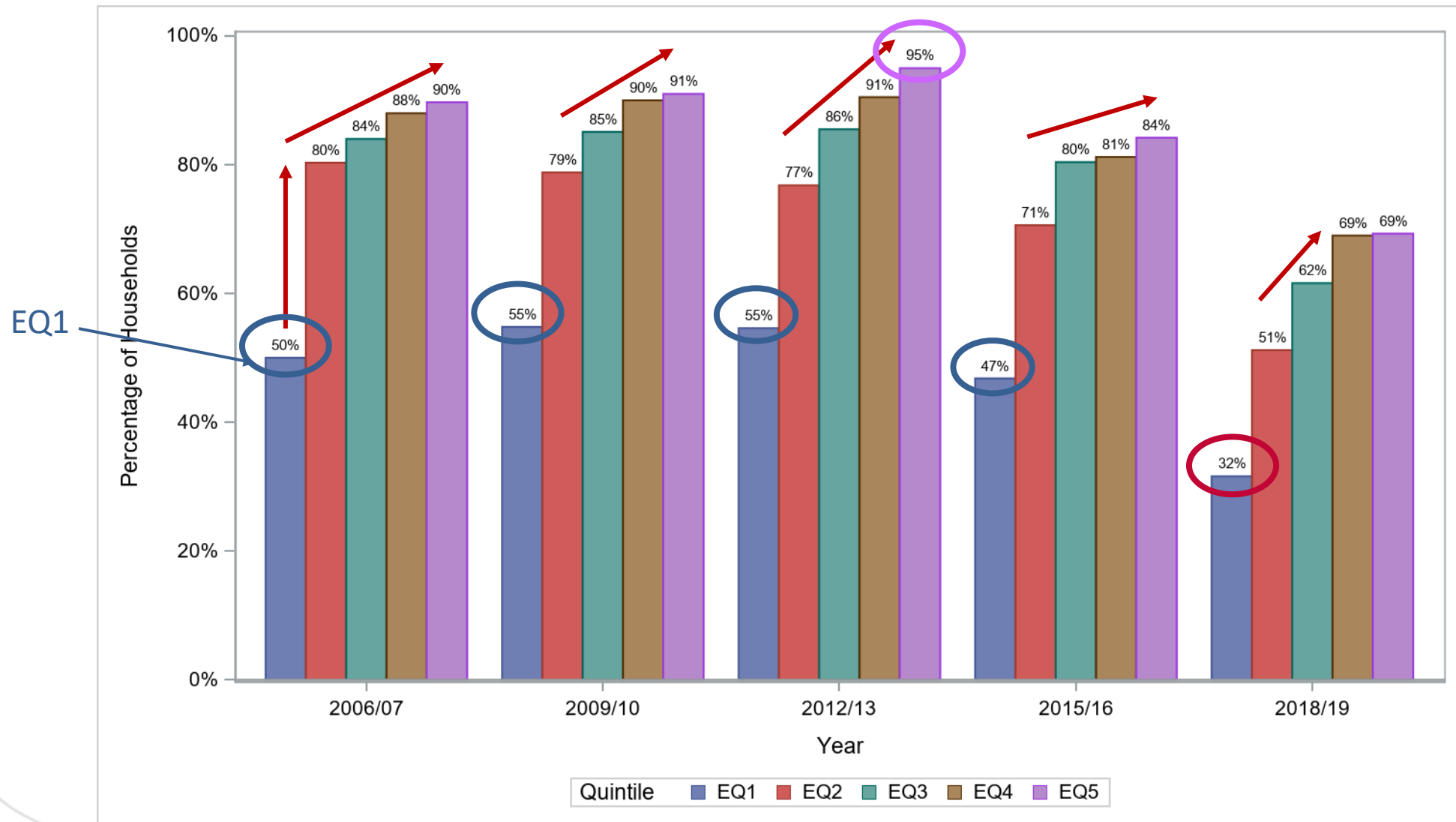
Quintiles



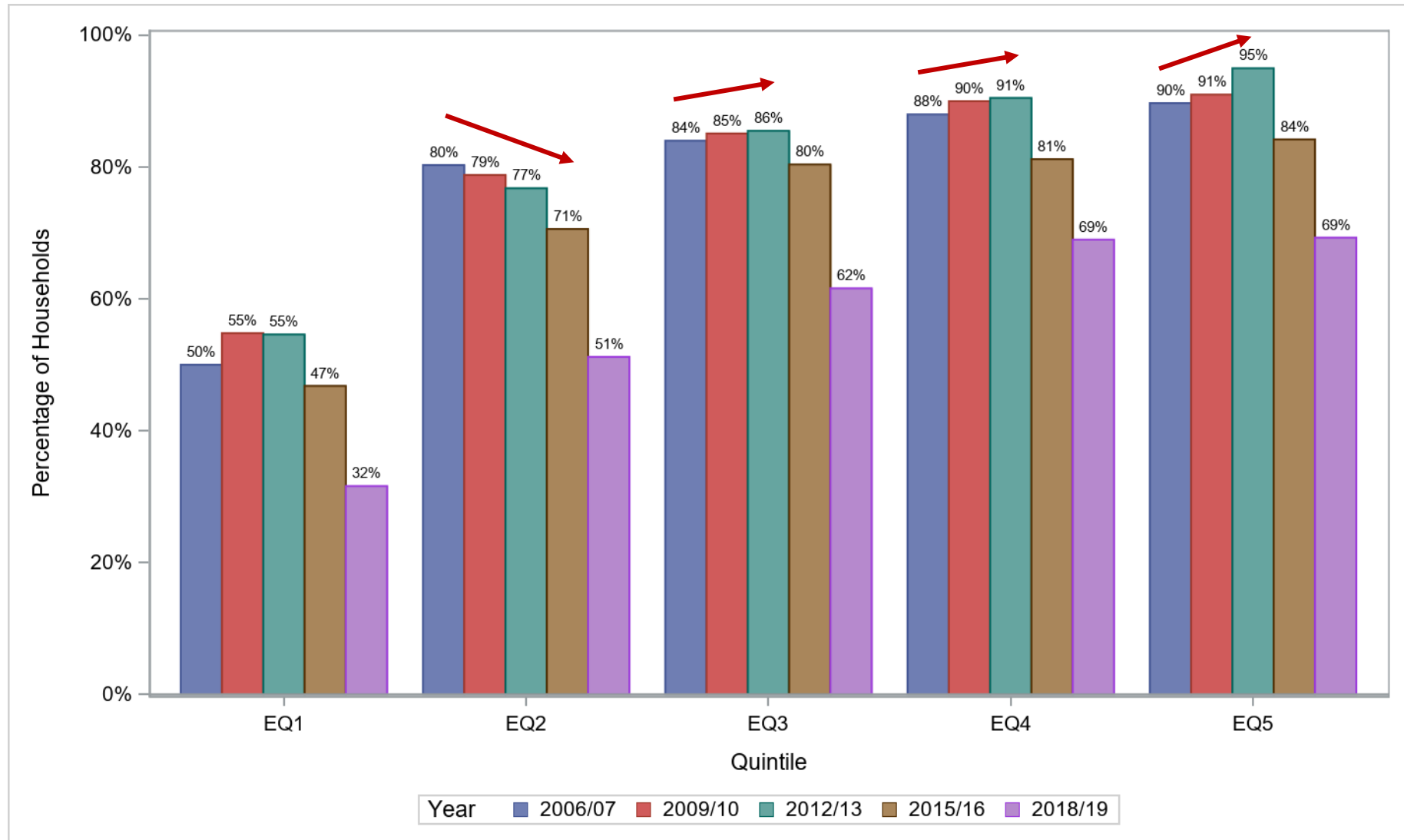
Fuel Expenditure Follows Petrol Price



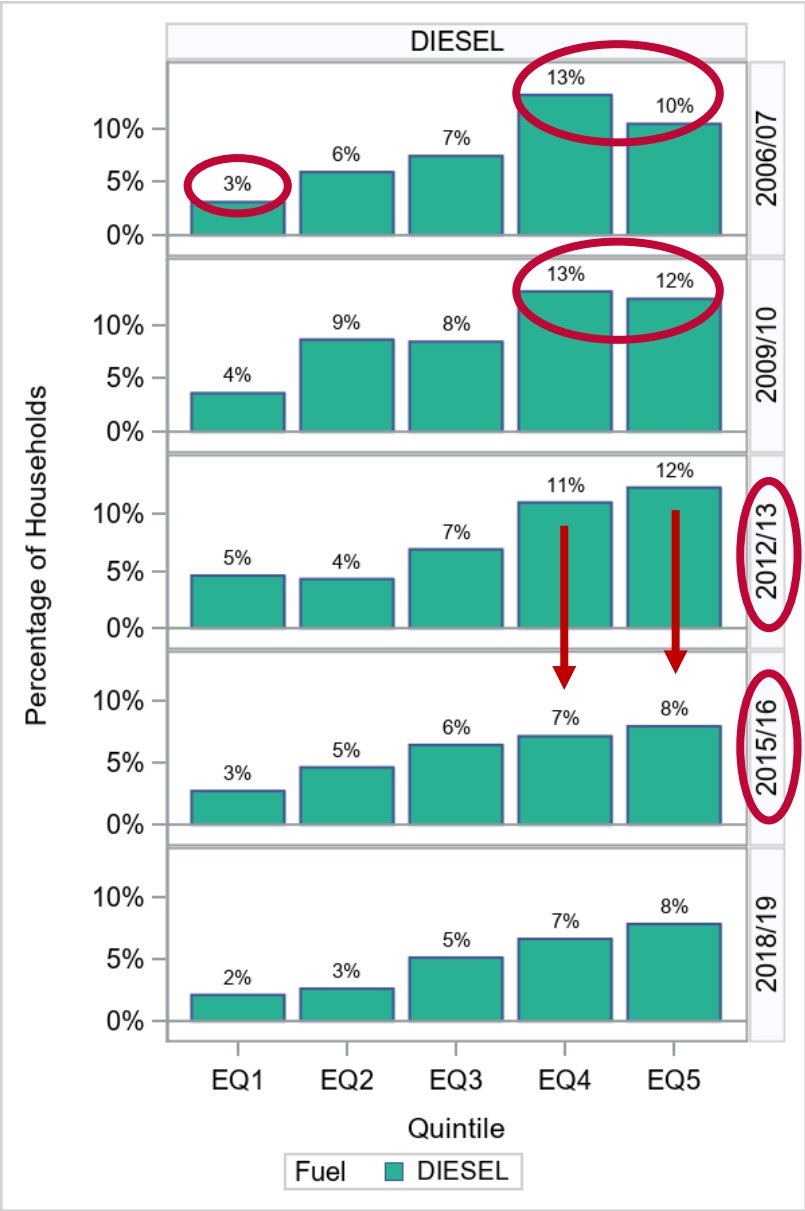
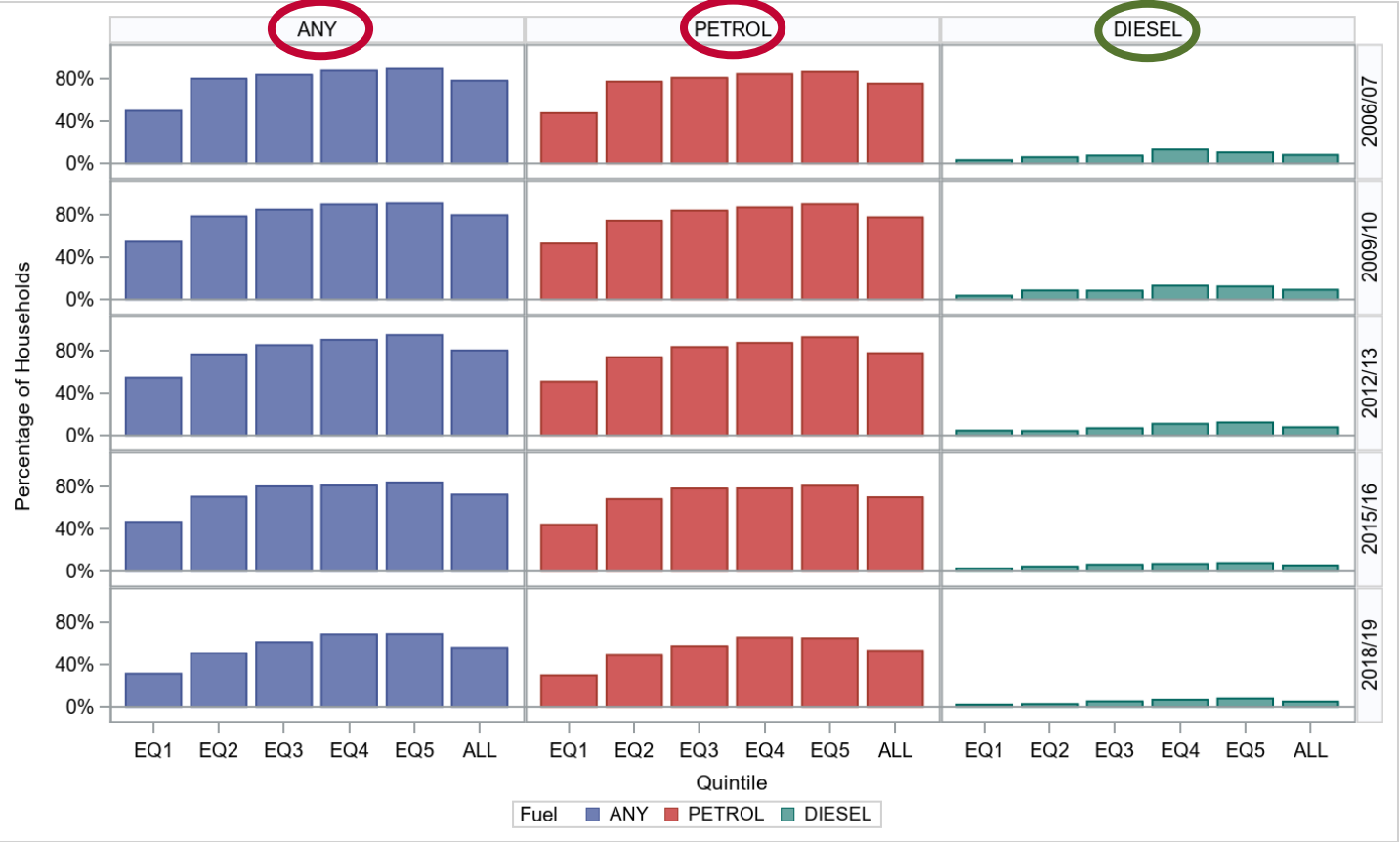
Low Income HH Least Likely to Report Fuel



Households Reporting Fuel Expenditures by EQ



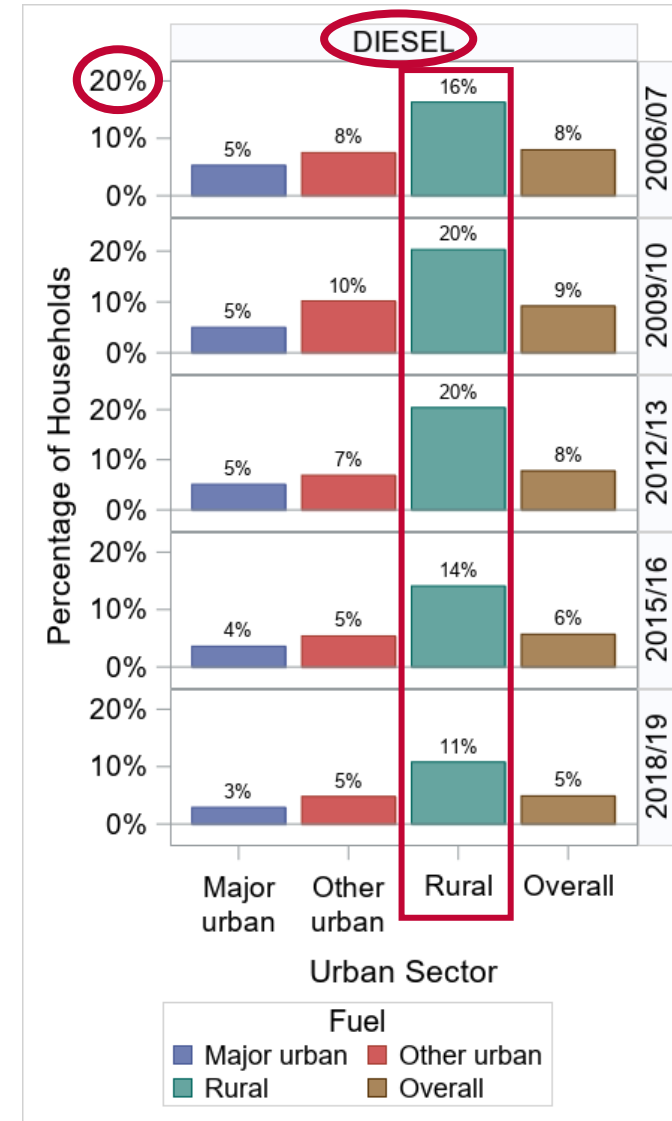
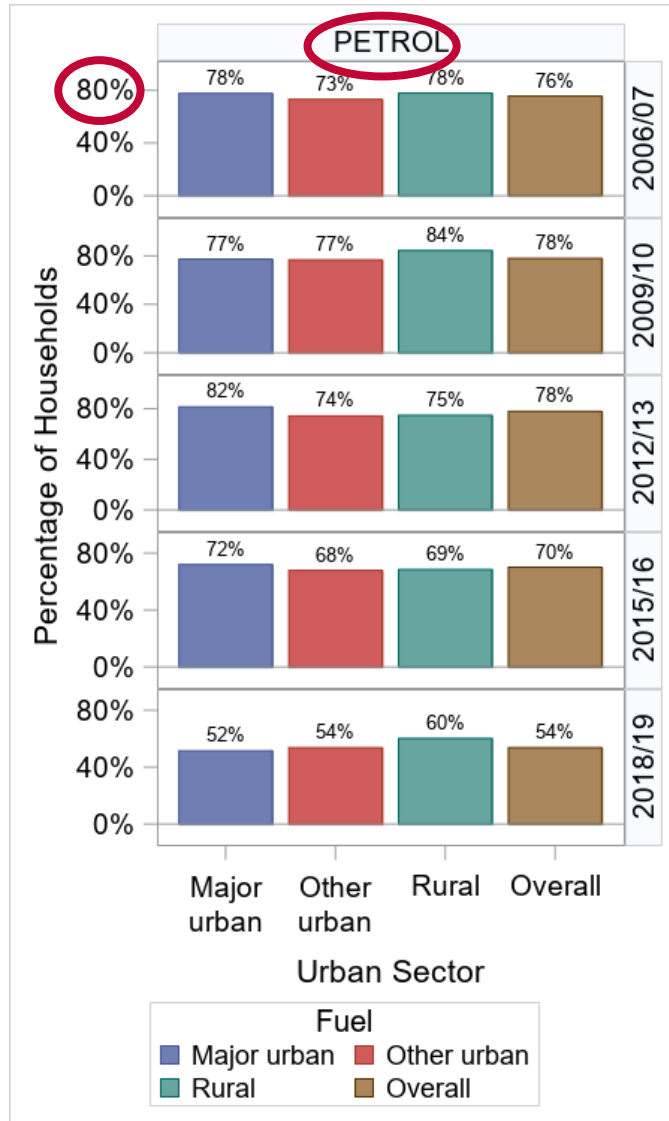
Diesel Use Lower than Petrol



Urban and Rural Fuel Reporting Changing



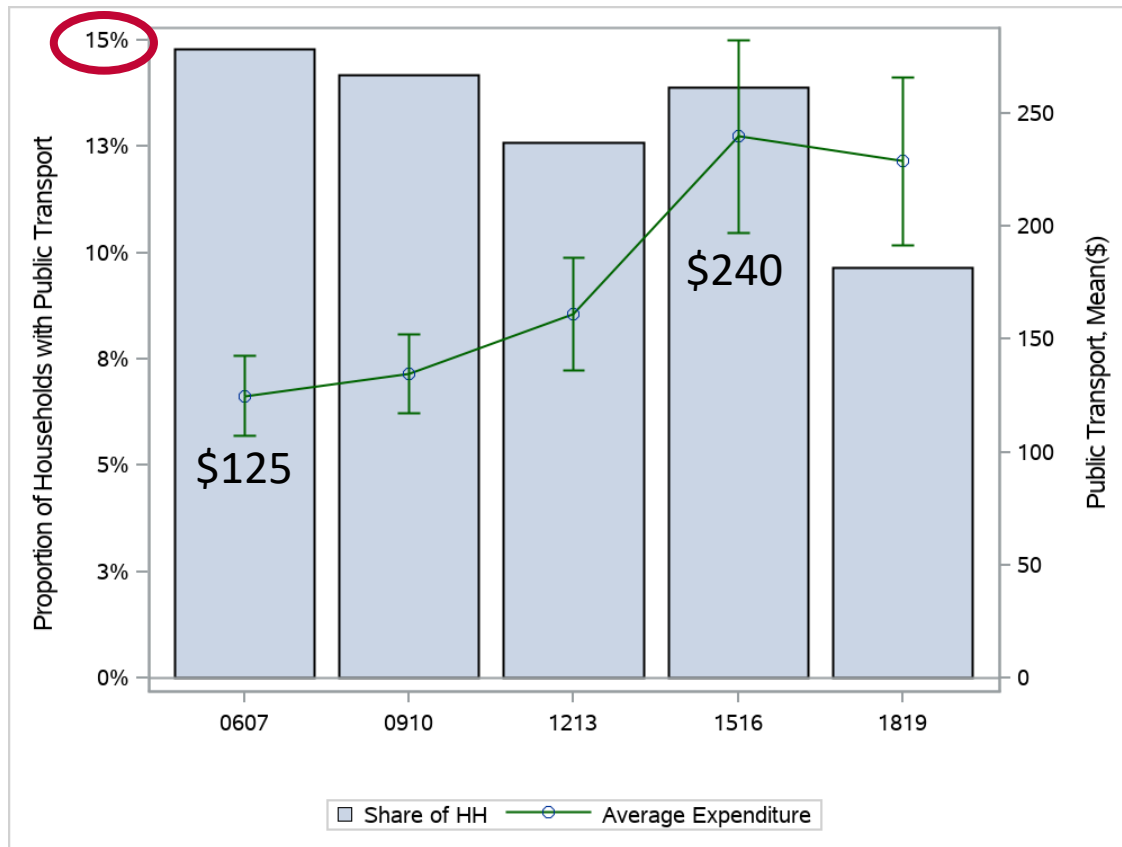
Diesel Reporting Higher in Rural Areas



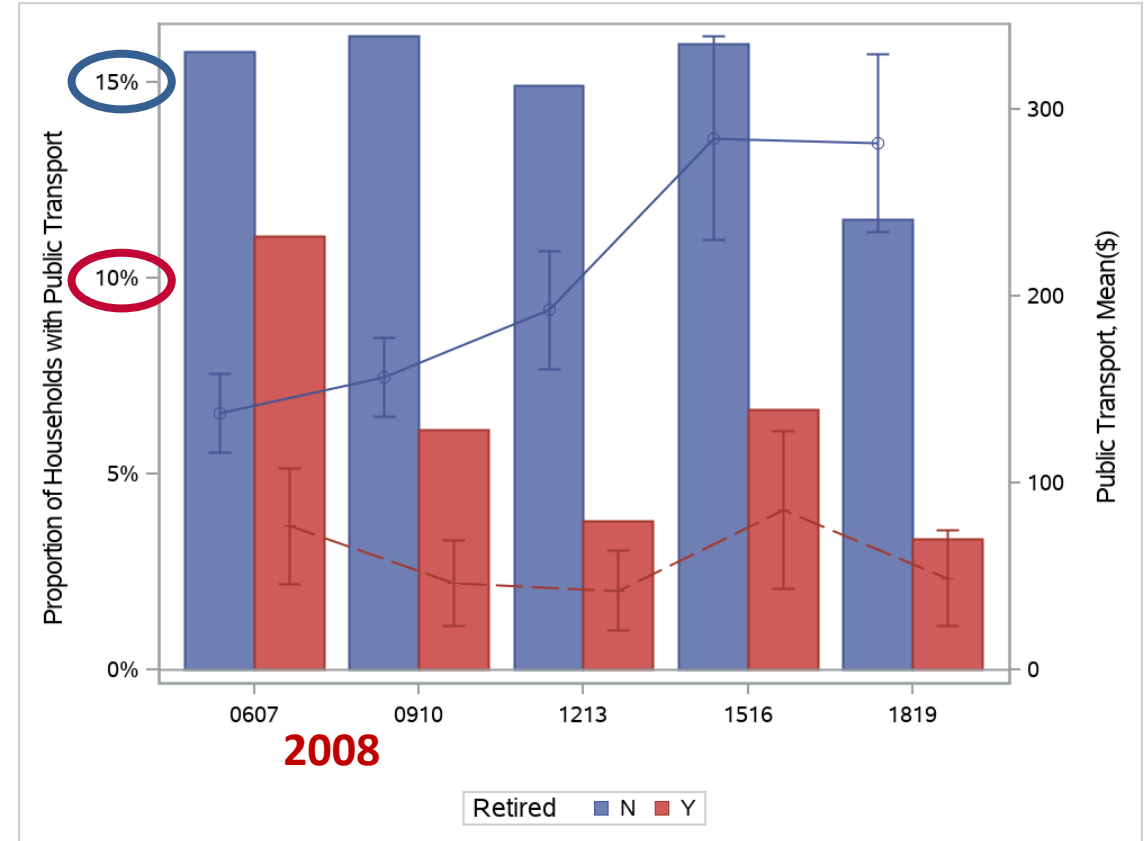
Public Transport Expenditure (PTX)

Lower Reporting of PTX Compared to Fuels

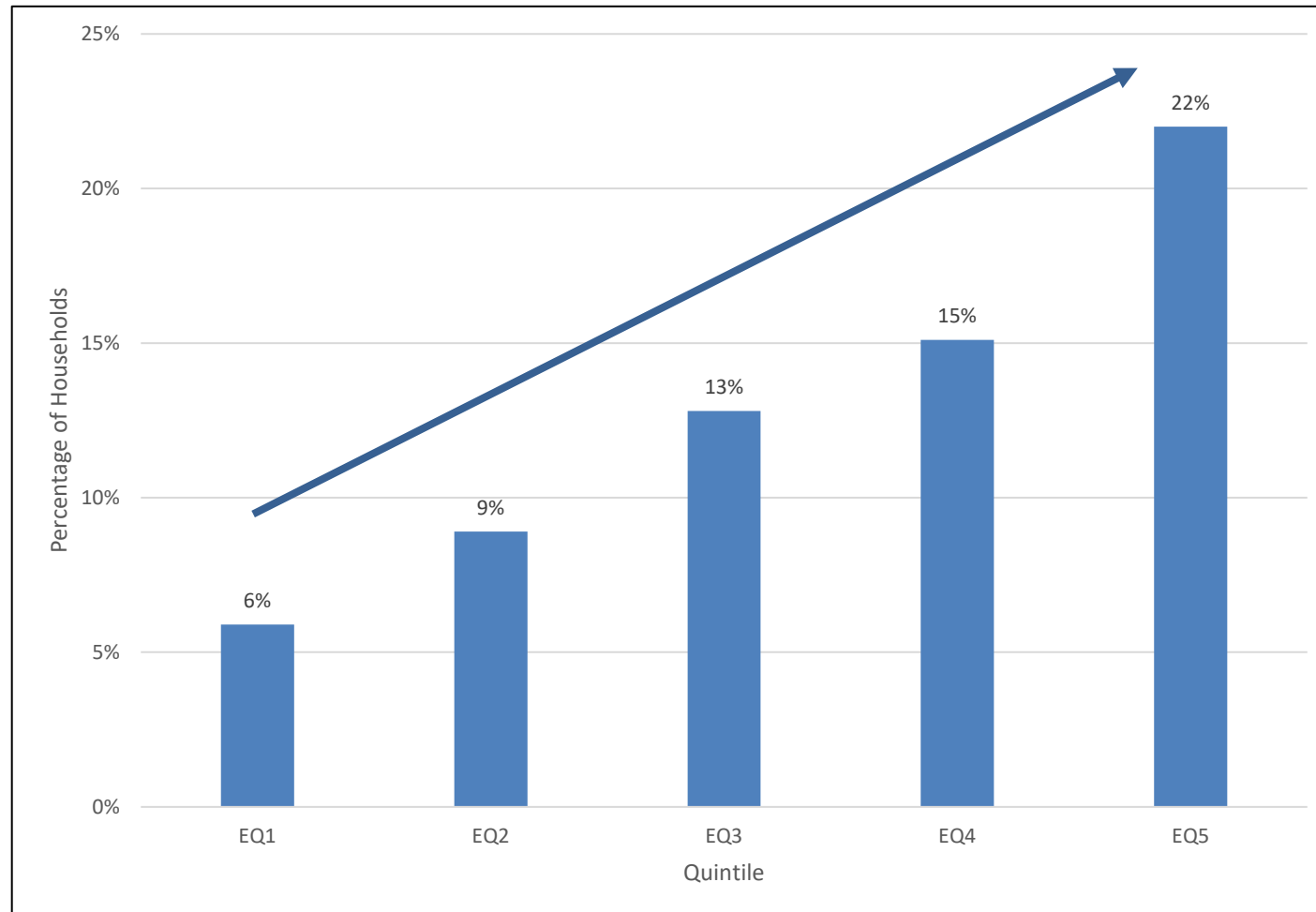
\$800 **All HHs** **\$1700**



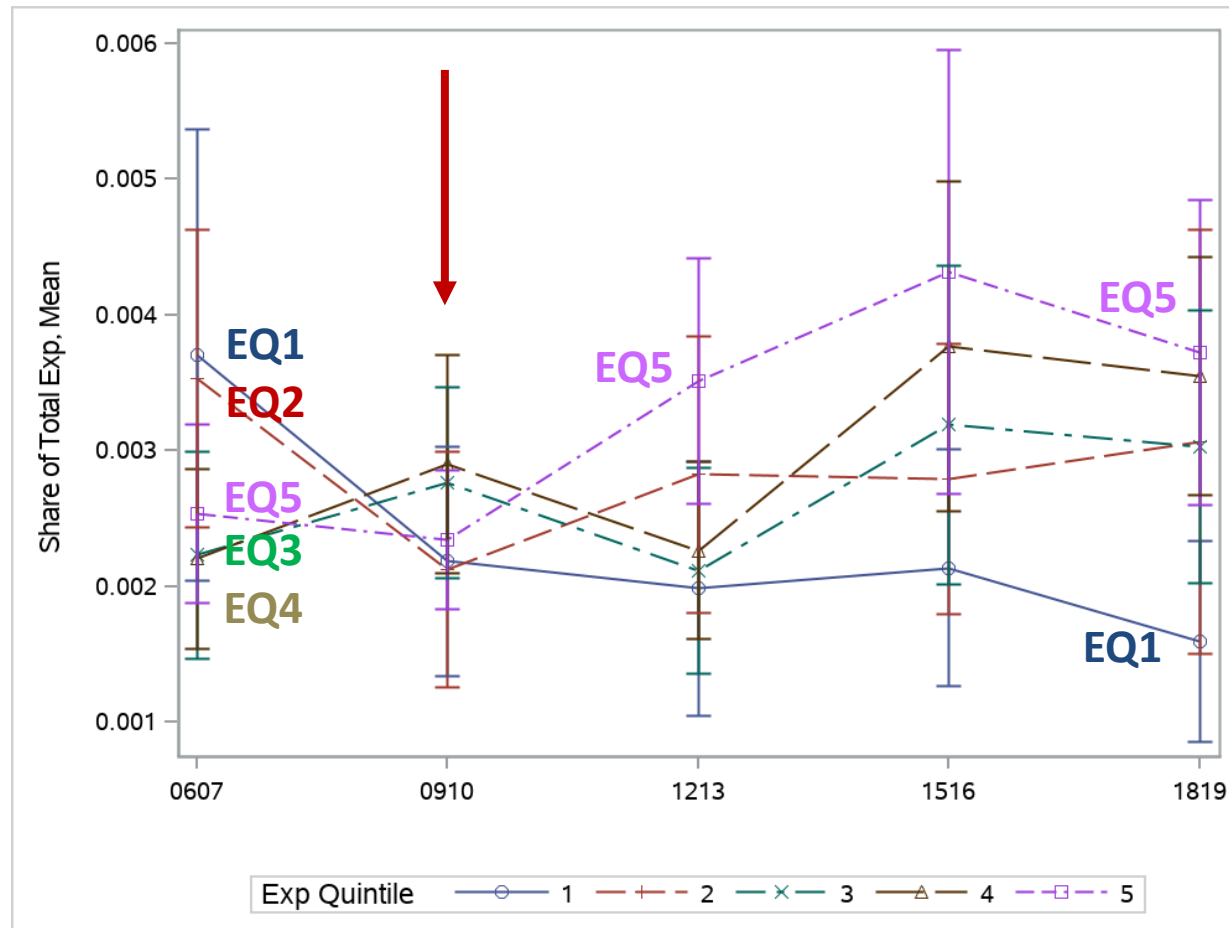
Retiree HHs



Higher Income HHs More Likely to Report PTX



Changes in Total Expenditure Shares – PTX



Results from Logistic Regressions

	Any Fuel Expenditures (0/1)			PTX (0/1)		
PTX (0/1)	-0.240*** (0.0688)					
FX (0/1)				-0.261*** (0.0707)		
EQ2	0.882*** (0.0652)	0.885*** (0.0652)	0.879*** (0.0643)	0.236** (0.119)	0.290** (0.119)	0.240** (0.119)
EQ3	1.251*** (0.0751)	1.262*** (0.0749)	1.249*** (0.0741)	0.576*** (0.122)	0.649*** (0.124)	0.573*** (0.123)
EQ4	1.534*** (0.0852)	1.550*** (0.0854)	1.547*** (0.0839)	0.709*** (0.126)	0.794*** (0.128)	0.701*** (0.126)
EQ5	1.855*** (0.0985)	1.882*** (0.0992)	1.911*** (0.0996)	1.055*** (0.131)	1.151*** (0.133)	1.056*** (0.130)
Secondary	0.112 (0.0718)	0.112 (0.0718)	0.123* (0.0705)	0.174 (0.127)	0.185 (0.127)	0.183 (0.126)
Post-secondary	0.198*** (0.0733)	0.196*** (0.0734)	0.191*** (0.0721)	0.0750 (0.130)	0.0853 (0.130)	0.0765 (0.130)
Bachelor	0.109 (0.0870)	0.121 (0.0871)	0.0757 (0.0856)	0.579*** (0.135)	0.587*** (0.135)	0.570*** (0.134)
Post-grad	-0.0272 (0.0892)	-0.00832 (0.0895)	-0.0700 (0.0885)	0.728*** (0.135)	0.731*** (0.135)	0.722*** (0.135)
Housing Costs	-1.72e-05*** (2.54e-06)	-1.75e-05*** (2.55e-06)	-2.16e-05*** (2.52e-06)	-8.59e-06*** (2.79e-06)	-9.26e-06*** (2.80e-06)	-9.77e-06*** (2.76e-06)
Dist to TAW (min)	0.00519** (0.00212)	0.00503** (0.00212)	0.00474** (0.00207)	-0.0144*** (0.00450)	-0.0141*** (0.00449)	-0.0151*** (0.00457)

Results from Linear Regressions (Fuel)

	(1) Fuel Expenditures (\$)	(2) Fuel Expenditures (LN)	(3) Fuel Expenditures (SH)
Petrol Price (c/l)	10.26*** (1.047)	0.00677*** (0.000328)	2.47e-05 (2.16e-05)
EQ2	678.2*** (50.33)	0.287*** (0.0279)	0.000507 (0.00231)
EQ3	1,365*** (69.07)	0.515*** (0.0297)	-0.00252 (0.00256)
EQ4	2,093*** (85.99)	0.682*** (0.0313)	-0.00697*** (0.00266)
EQ5	3,094*** (116.5)	0.863*** (0.0352)	-0.0133*** (0.00276)
Secondary	-68.88 (61.39)	-0.0260 (0.0285)	0.00170 (0.00188)
Post-secondary	220.0*** (66.99)	0.0536* (0.0283)	0.00669*** (0.00199)
Bachelor	54.72 (91.83)	0.0298 (0.0331)	0.00231 (0.00206)
Post-grad	-139.9 (93.87)	0.0150 (0.0336)	-0.00123 (0.00200)
Public Rental	-93.47 (78.69)	-0.0636* (0.0331)	-0.00625*** (0.00191)
Private Rental	-44.47 (68.79)	-0.0843*** (0.0205)	-0.00224* (0.00136)
Retiree	-179.1*** (59.26)	-0.0719*** (0.0216)	-0.00805*** (0.00146)
Housing Costs	-0.0181*** (0.00413)	-2.57e-06*** (8.54e-07)	-4.70e-07*** (4.00e-08)
Dist to TAW (min)	13.91*** (2.384)	0.00438*** (0.000807)	0.000298*** (5.32e-05)
Observations	16,146	11,217	16,146
R-squared	0.212	0.248	0.054

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Main Results from Fuel (FX) Regressions

- Higher prices associated with higher FX BUT fuel price did not significantly affect share of HH budgets allocated to fuel
- Higher expenditure HH had significantly higher FX BUT only EQ4 and EQ5 allocated significantly smaller budget share compared to EQ1-EQ3
- HH with a post-secondary degree as the highest qualification spent significantly more on fuel AND allocated a significantly larger share budget
- Rentals (both public and private)
 - lower FX conditional on having FX
 - Only HH in public rentals allocated a significantly smaller share of HH budget to FX
- Retiree HHs had significantly lower FX & allocated a significantly smaller budget share
- As housing costs increase, HH FX decreases and smaller share of total budget allocated to FX.
- As distance from an economic centre increased, FX also increased as did budget share
- HH with PTX
 - spent similar amounts on fuel compared to those without (conditional on FX)
 - allocated a significantly smaller share of their total expenditures to fuel.

Main Results from PTX Regressions

- As petrol prices increased, households spent more on public transport.
- Higher expenditure HH spent significantly more on public transport than lower expenditure households; however, all HH allocated similar shares of their budget to PTX
- Households in public rentals allocated a significantly larger share of their household budget to PTX
- Conditional on having PTX, PTX increased as the distance from an economic centre increased.

Conclusions

- Different HH types tend to have different expenditure patterns (e.g., retirees)
- Share of HH budget allocated to fuel is similar for all HH using descriptive statistics but adding controls indicates that higher income HH allocate lower share
 - Overall, transport policies likely to be proportional
 - May depend on exactly which factors affect lower shares by higher income HH
- Public transport more likely to be used by HH with higher incomes and education living in more densely populated areas

The End