Energy efficiency policies targeting consumers may not save energy in the long run: The case of a policy in the Israeli private car market

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Policy coverage in 2019



Market size, 2019

0 39679
500000
1000000
15000000
21444180

Policy coverage

□ no ■ yes

The direct rebound effect



Literature review

- Studies treat policies regulating energy efficiency as largely effective despite the rebound (e.g., Gillingham et al., 2013; Greene et al., 2020)
- Short-run rebound effect of 10-12%, and long-run effect of 26-29% (Dimitropoulos et al., 2018)
- Germany: 40-70% (Frondel et al., 2008; 2012; 2017; Frondel & Vance, 2009; 2013; 2017)
- Canada: 82-88% (Moshiri & Aliyev, 2017)
- France, Germany, Italy, UK: 78-101% (Berner et al., 2021)

Policies regulating manufacturers

- The Corporate Average Fuel Economy (CAFE) regulation-type has become a global golden standard
- Evidence from the US suggests that rebound effects stemming from CAFE standards decline over time (e.g., Small & Van Dender, 2007; Green, 2012; Hymel & Small, 2015; Greene et al. 2020)

Policies targeting consumers

- Policies affecting the demand side by incentivizing consumers to buy energy-efficient cars
- Some countries have adopted both policy types (e.g., Germany, Canada, Japan, the UK, France, and Spain)
- Others target only consumers (e.g., Sweden, Finland, and Israel)
- Limited literature estimating rebound effects under policies targeting consumers (e.g., Steren, Rubin and Rosenzweig, 2016; Andersson et al., 2019; Yoo, 2019)

Research questions

- 1. Do policies incentivizing consumers to buy energy-efficient cars generate a distinct rebound effect?
- 2. If so, what is the nature of this rebound in terms of magnitude and persistence?

The policy in Israel

Pollution level	Effective tax rate (NIS)
15	80%
14	73%
13	74%
12	76%
11	71%
10	69%
9	64%
8	62%
7	64%
6	60%
5	60%
4	49%
3	39%
2	36%
2 (Hybrid)	28%
2 (Plug-In Hybrid)	17%
1 (Electric)	9%

New cars marketed in Israel



(Israel Tax Authority, 2016)

- 19,381 households 2007 2016 (Central Bureau of Statistics)
- Energy efficiency data (The Vehicle Certification Agency in the UK Department for Transport)
- Car prices (Levi Itzhak vehicle price list)
- Fuel prices (Israeli Ministry of Energy)

Real price of fuel



(Based on Israel Ministry of Energy, 2021; U.S. Energy Information Administration, 2021)

Empirical model

$$ln(\mu_i) = \alpha_0 + \alpha_1 ln(lp_i) + \alpha_2 ln(v_i) + \alpha_3 ln(a_i) + \sum_{j=4}^{J} \alpha_j X_{ij-3} + \theta_i$$

$$ln(s_i) = \beta_0 + \beta_1 ln(\mu_i) + \sum_{k=2}^{K} \beta_k X_{ik-1} + \varepsilon_i$$

Where:

 μ_i fuel efficiency

 s_i monthly kilometers traveled

 lp_i lagged fuel prices

 $oldsymbol{
u}_i$ car value $oldsymbol{a}_i$ car age

 X_{ik} control variables

Rolling window technique

				Winc	1899 wint	Win2	Wing	bWinte	Win5	Wing	Www.7d	&Vvin&	Win ®	Skindo	Window
													1		1
															- i -
i	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	
	2007 2008			2009			2010								

Estimation results



Conclusions

- A policy targeting consumers (vs. manufacturers) seems to generate a rebound with unique characteristics
- The energy-efficiency policy in Israel did not seem to save energy in the long run
- Because of considerable negative externalities, policymakers should consider moderating car usage by:
 - Fuel taxing
 - Km traveled taxing



Thank You!

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Regressions results – km traveled model

	Time period				
Variable	Q1 2007 - Q4 2008	Q4 2009 - Q3 2011	Q1 2010 - Q4 2011	Q1 2015 - Q4 2016	
In(energy efficiency) (km/liter)	0.045 (0.226)	0.286 (0.213)	0.550 (0.209)***	1.091 (0.104)***	
In(real fuel price) (NIS/liter)	-0.636 (0.159)***	-0.438 (0.255)*	-0.453 (0.266)*	-1.127 (0.194)***	
In(real net monthly income) (NIS)	0.153 (0.027)***	0.172 (0.022)***	0.177 (0.022)***	0.124 (0.019)***	
Cars in the household (#)	0.080 (0.030)***	0.123 (0.026)***	0.139 (0.026)***	0.157 (0.0200)***	
Residency in a periphery area (yes/no)	0.062 (0.025)**	0.090 (0.023)***	0.088 (0.023)***	0.0789(0.019)***	
Age of the head of household	0.003 (0.006)	0.006 (0.006)	0.007 (0.006)	-0.002 (0.005)	
Squared age of the head of household	-8.04e-05 (6.03e-05)	-0.001 (5.59e-05)**	-0.001 (5.54e-05)**	-3.18e-05 (4.64e-05)	
Household head has an academic degree (yes/no)	0.027 (0.031)	0.041 (0.028)	0.046 (0.028)	0.070 (0.023)***	
Household head has a matriculation certificate (yes/no)	0.005 (0.032)	0.002 (0.030)	-0.006 (0.030)	-0.008 (0.025)	
No spouse (yes/no)	0.001 (0.048)	0.034 (0.045)	0.029 (0.045)	-0.040 (0.039)	
Head of household is a woman (yes/no)	-0.053 (0.026)**	-0.077 (0.024)***	-0.095 (0.024)***	-0.071 (0.020)***	
Head of household is self-employed (yes/no)	-0.267 (0.043)***	-0.305 (0.038)***	-0.290 (0.038)***	0.039 (0.030)	
Head and spouse do not work (yes/no)	0.016 (0.043)	0.085 (0.039)**	0.103 (0.039)***	-0.038 (0.033)	
Individuals under 18 in household (#)	0.010 (0.011)	0.002 (0.010)	0.012 (0.010)	0.001 (0.008)	
Individuals aged 18 and up in household (#)	0.031 (0.015)**	0.0275 (0.014)**	0.024 (0.014)*	0.015 (0.011)	
Constant	6.662 (0.765)***	5.420 (0.738)***	4.712 (0.737)***	5.147 (0.483)***	
Observations	3,044	3,403	3,461	4,028	

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

Robustness check– Policy and amendments as IV's

	Policy regime					
Variable	2009 policy (Jan 2007 – July 2013)	2013 amendment (Aug 2009 – Jan 2015)	2015 amendment (Aug 2013 – Dec 2016)			
In(energy efficiency) (km/liter)	0.553 (0.110)***	0.612 (0.094)***	0.934 (0.088)***			
In(real fuel price) (NIS/liter)	-0.492 (0.074)***	-0.767 (0.113)***	-1.311 (0.073)***			
In(real net monthly income) (NIS)	0.157 (0.012)***	0.154 (0.013)***	0.126 (0.015)***			
Cars in the household (#)	0.133 (0.014)***	0.135 (0.014)***	0.140 (0.016)***			
Residency in a periphery area (yes/no)	0.075 (0.012)***	0.090 (0.013)***	0.091 (0.015)***			
Age of the head of household	0.005 (0.003)*	0.005 (0.003)	0.001 (0.004)			
Squared age of the head of household	-9.41e-05 (2.99e-05)***	-9.53e-05 (3.22e-05)***	-5.85e-05 (3.91e-05)			
Household head has an academic degree (yes/no)	0.025 (0.015)*	0.033 (0.016)**	0.049 (0.0184)***			
Household head has a matriculation certificate (yes/no)	0.026 (0.016)*	0.014 (0.016)	0.001 (0.019)			
No spouse (yes/no)	-0.001 (0.024)	0.008 (0.025)	0.001 (0.030)			
Head of household is a woman (yes/no)	-0.071 (0.013)***	-0.067 (0.013)***	-0.064 (0.016)***			
Head of household is self-employed (yes/no)	-0.257 (0.020)***	-0.264 (0.021)***	-0.100 (0.024)***			
Head and spouse do not work (yes/no)	0.064 (0.021)***	0.062 (0.022)***	-0.015 (0.0256)			
Individuals under 18 in household (#)	0.004 (0.005)	0.005 (0.006)	0.008 (0.007)			
Individuals aged 18 and up in household (#)	0.029 (0.007)***	0.022 (0.008)***	0.013 (0.009)			
Constant	4.935 (0.331)***	5.327 (0.335)***	5.807 (0.320)***			
Observations	12,143	11,326	7,237			