



The effect of culture on energy efficient vehicle ownership

Tobias Wekhof

June 21, 2018

Table of Contents

1. The role of Culture in Economics
2. Estimation Strategy – Fuzzy Spatial RDD
3. Results
4. Conclusion
5. References
6. Appendix: Robustness Checks and Graphs

The Role of Culture in Economics (1/4)

- Culture important factor in economic decision making: e.g. saving rates (Guiso et al., 2006) or pursuing business relations (Ahern et al., 2015)
- Guiso et al., (2006): culture as *“customary beliefs and values that ethnic, religious, and social groups transmit fairly unchanged from generation to generation”*

The Role of Culture in Economics (2/4)

- Objective: Analyze the impact of culture on consumer preferences for energy efficient cars.
 - Challenge: Cannot rely on a cross-country comparison: culture and institutions are both complements and interact in their impact on economic development (Alesina and Giuliano, 2015)
- Solution: Analysis of several cultural groups within one country, most political and other institutions are homogeneous

The Role of Culture in Economics (3/4)

Environmental Economics

- Culture in theoretical models (Bezin, 2015, Schumacher 2009, 2015)
- Empirical evidence of culture: stated preferences (CVM) (Wilhite et al., 1996, Shultz et al., 1998, Hoyos et al., 2009)
- Culture forms attitudes (Gifford and Nilsson, 2014), attitudes lead to environmental decisions (Kahneman et al., 1999)
- Broad literature on effect of attitudes on environmental decision making (Brounen and Kok, 2011, Costa and Kahn, 2013, Videras et al., 2012, Welsch and Kühling, 2009)

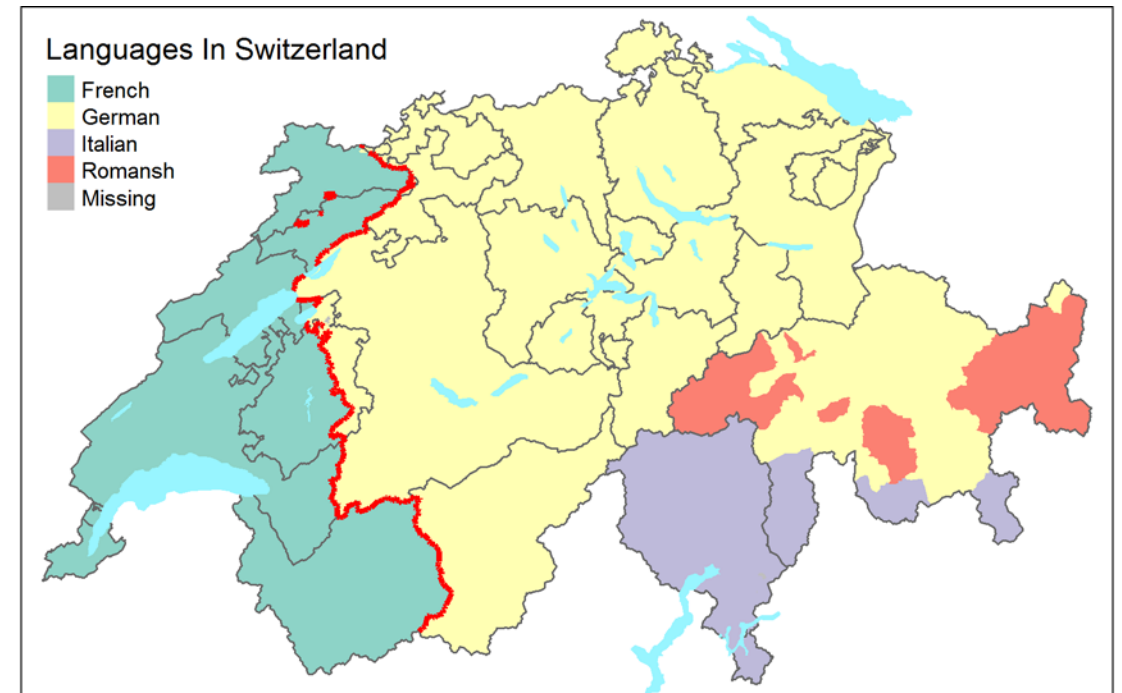
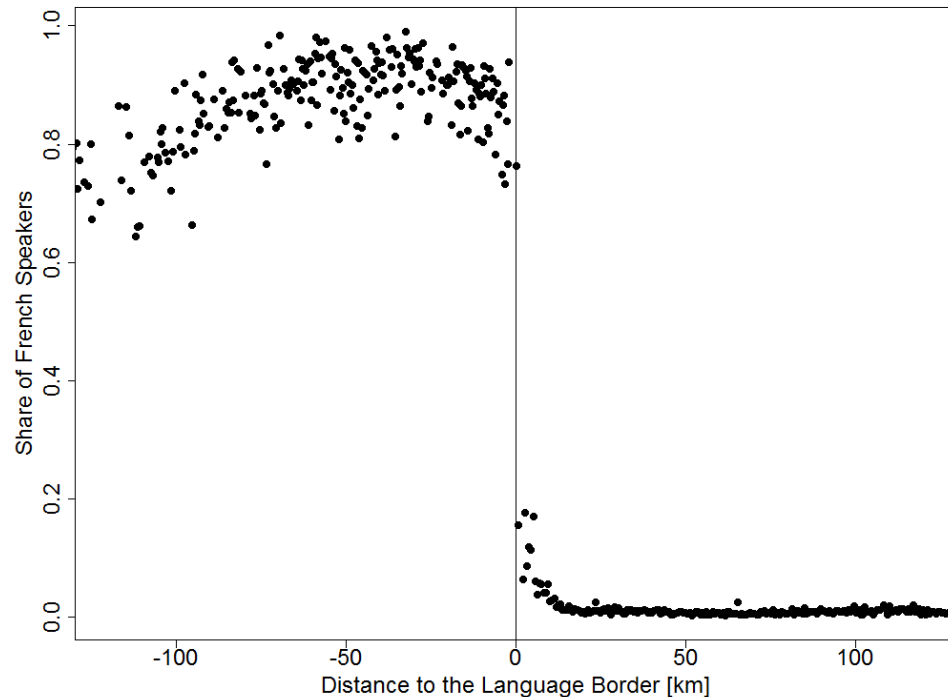
The Role of Culture in Economics (4/4)

Environmental Economics

- Car sector: influence of environmental attitudes on efficient vehicle choice (Gallagher and Muehlegger, 2011, Kahn, 2007)
- Attitudes depend on culture! (Hence, also environmental decisions)
- Contribution:
 1. first empirical analysis on relation between culture and environmental preferences using revealed preferences
 2. connect the literature on influence of attitudes to the underlying impact of culture

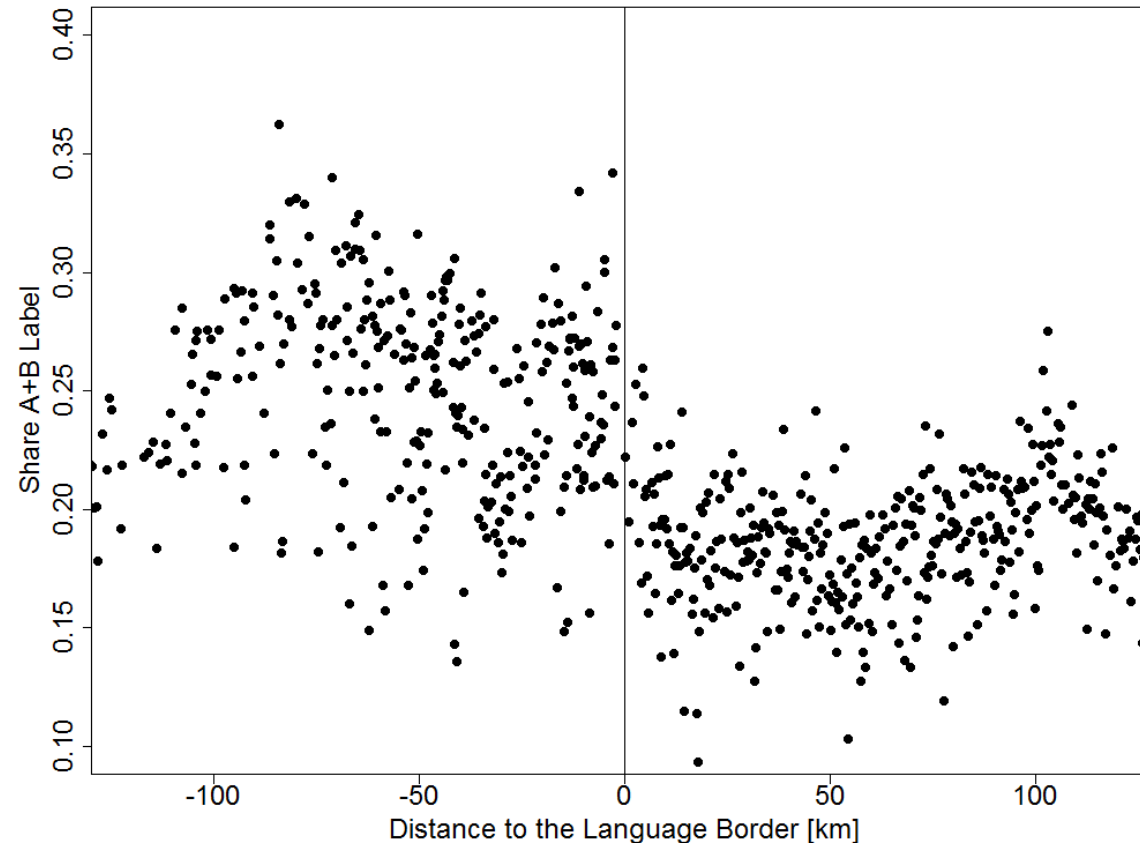
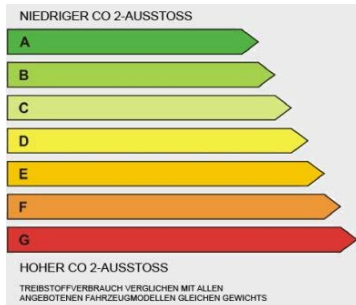
Estimation Strategy (1/4)

- cross country level: not possible to distinguish between institutional effect and individual consumer choices.
- language as a proxy for variation in culture and as a determinant of economic outcomes, e.g. (Fearon, 2003) or (Chen, 2013)
- Switzerland: culturally distinct groups, live in the same country and share all institutions



Estimation Strategy (2/4) – spatial fuzzy RDD

used for Switzerland by Eugster et. al (2011) in labor economics, Egger and Lassmann (2016) international trade and Gentili and Mazzonna (2017) for elderly care



Individual vehicle data,
aggregated on municipality
level

Estimation Strategy (3/4): Balanced Covariates

Table 1: Variables for 2010, 25km range of language border

	mean French	mean German	Difference	RDD Estimate
Share French	0.87 (0.08)	0.03 (0.06)	0.84***	0.71*** (0.02)
Share A- and B-Label	0.24 (0.05)	0.18 (0.04)	0.06***	0.04*** (0.01)
Median CO ₂ Emissions	177.97 (6.95)	184.35 (7.97)	-6.38***	-1.37 (1.67)
Median Fuel Econ.	7.3 (0.3)	7.58 (0.36)	-0.28***	-0.06 (0.07)
Income/Capita	23.2 (3.22)	23.84 (4.68)	-0.64	-0.03 (1.02)
Population Density	2.59 (4.39)	3.34 (5.46)	-0.75	0.36 (1.41)
Elevation	814.26 (310.76)	657.73 (351.03)	156.53***	207.48*** (67.55)
Quality Pub. Transport	0.16 (0.37)	0.16 (0.36)	0	-0.04 (0.08)
Share Urban	0.02 (0.14)	0.01 (0.08)	0.01	0 (0.03)
Share French Cars	0.2 (0.06)	0.18 (0.06)	0.02***	0.01 (0.02)
Green-Party 2011	9.76 (4.01)	10.46 (4.52)	-0.7	0.43 (1.1)
Green-Party 2015	8.75 (3.61)	8.95 (4.01)	-0.2	-0.63 (1.05)

Estimation Strategy (4/4): Model – 2SLS, 2nd Stage

$$Y_i = \beta_0 + \beta_1 language_i + \beta_2 F_{i,fr} + \beta_3 F_{i,fr}^2 + \beta_4 F_{i,ger} + \beta_5 F_{i,ger}^2 + \beta_6 X_i + \epsilon_i \quad (2)$$

Y: share of efficient vehicles per municipality

language: share French speakers

F: driving distance to language border (polynomials)

X: Socio-economic covariates: population density, income per capita, share of french cars, elevation, urban dummy

Canton Fixed effects

Results (1/4)

Table 3: RDD Cross Section - 2nd Stage

		(1)	(2)	(3)	(4)	(5)
<i>Share of A- and B-label vehicles</i>						
2011	Share French	0.043*** (0.008)	0.048*** (0.009)	0.083*** (0.016)	0.063*** (0.014)	0.060*** (0.011)
	Observations	1,835	528	751	353	353
	R ²	0.515	0.549	0.478	0.522	0.675
2012	Share French	0.034*** (0.008)	0.036*** (0.009)	0.074*** (0.016)	0.054*** (0.015)	0.052*** (0.012)
	Observations	1,835	528	751	353	353
	R ²	0.500	0.496	0.437	0.480	0.645
Bandwidth		all CH	*Bilingual	50 km	25 km	25 km
Polynomial		Quadratic	Quadratic	Quadratic	Linear	Linear
Covariates		No	No	No	No	Yes

*Bilingual Cantons: Bern, Valais and Fribourg

Canton FE and control variables in all models

Heteroskedasticity Robust standard errors in parentheses

***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.10$

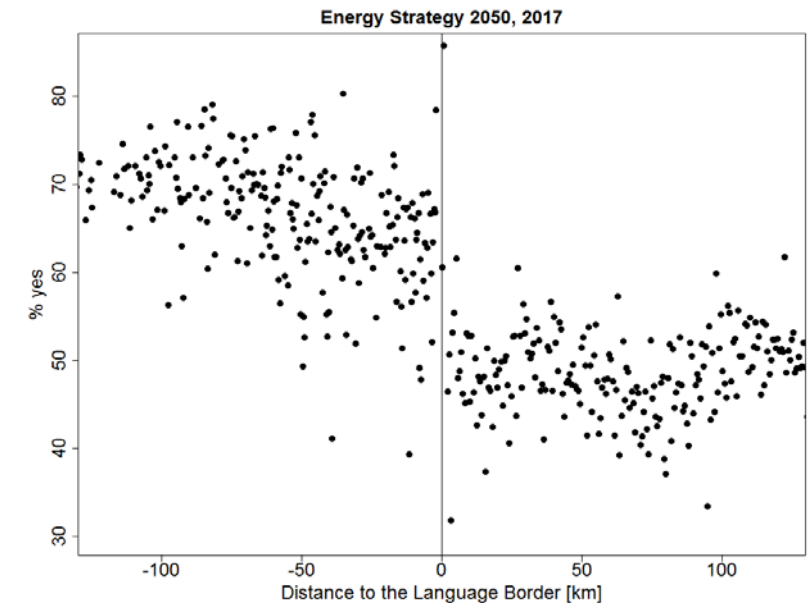
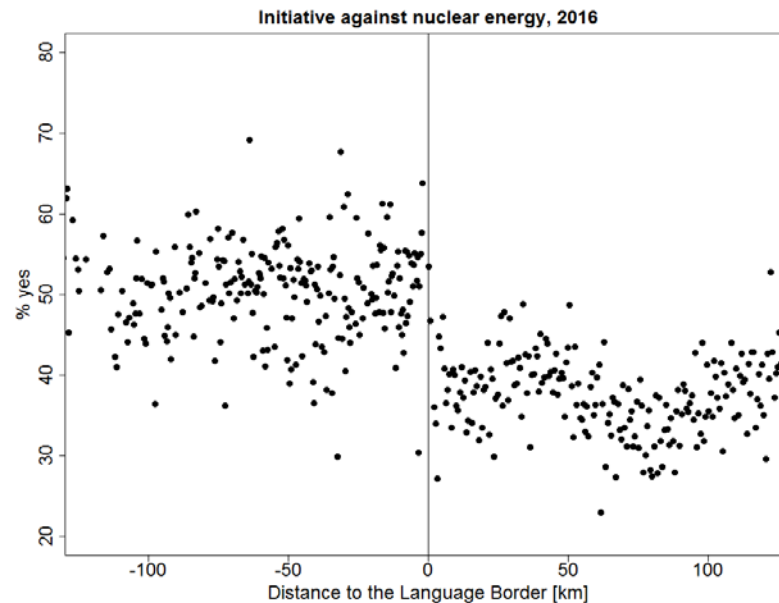
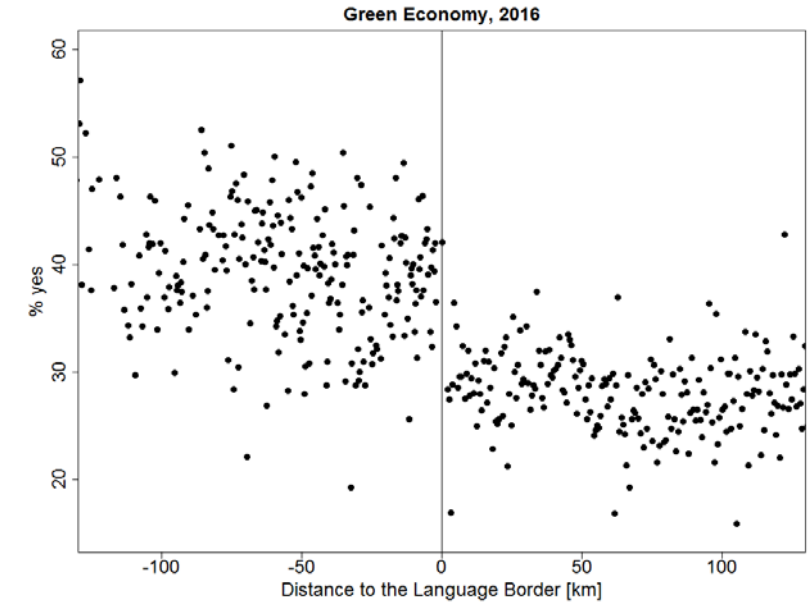
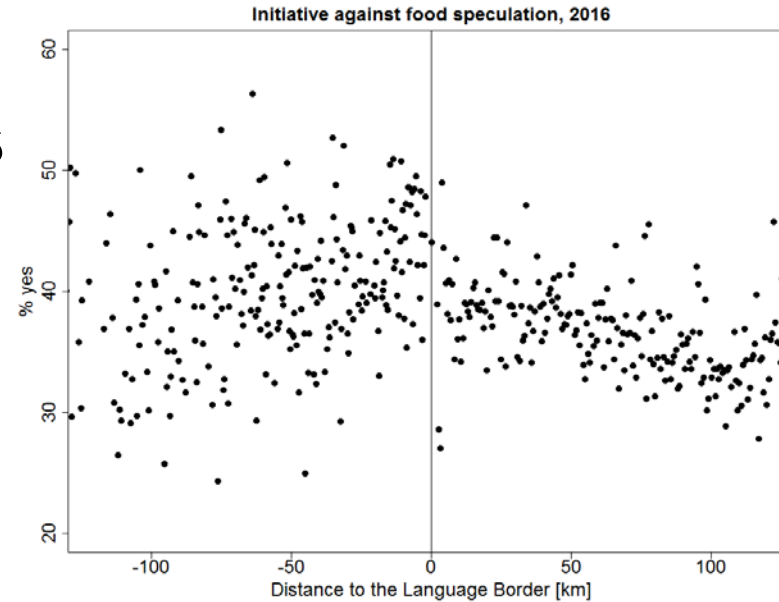
Results (2/4)

- Treatment effect: 5.5 percentage points
 - Explains 88% in the total difference between the two regions
- Magnitude of traditional policies:
 - Rebate of USD 1200 – 5.5 percentage point increase in energy efficient vehicles (Huse and Lucinda, 2014)
 - USD 2000 income tax deduction – explains 5% of hybrid sales (Beresteanu and Li, 2011)
 - 10% gasoline price increase – 8.6% increase in hybrid sales (Gallagher and Muehleger, 2011)

Results (3/4)

Voting outcomes

French speakers are
more favorable to
environmental issues



Results (4/4)

Possible explanations

- High wealth levels (Schumacher, 2015); future oriented behavior (Imhof et al., 2016)
 - Does not apply to the case of Switzerland
- Importance of collectivism and altruism (Gifford and Nilsson, 2014)
 - French part higher level of collectivism (Hofstede et al., 2010)
 - Higher level of altruism in French part (SHEDS data, Weber et al. (2017))
- trustworthiness of government (Tjernström and Tietenberg, 2008)
 - Acceptance of government power significantly higher in French parts (Hofstede et al., 2010)

Conclusion (1/2)

- Analyze how culture affects consumer preferences for fuel efficient vehicles.
 - support the literature that consumer choices are influenced by culture, independently of institutions (Atkin, 2016, Bisin and Verdier, 2001, Guiso et al., 2006).
- Add cultural dimension to environmental economics literature
- voting outcomes: consumers' concern for the environment is major channel of cultural influence, due to collectivism and altruism
 - Concerns for the environment have been identified by the literature as a factor for energy efficient vehicle choice (Gallagher and Muehlegger, 2011, Kahn, 2007).

Conclusion (2/2)

- Results are robust to various specifications (CO2 emissions and fuel efficiency dependent variables, individual linear probability model, non-parametric RDD)
- Results independent of vehicle brand and cantonal norms
- Policy makers:
 - introduce additional policy measures (e.g. marketing) which address culture and values as a factor.
 - direct traditional economic policy efforts to groups where the potential outcome is higher (here: German speaking regions)
 - Possible magnitude for influencing environmental culture (HarmoniCOP, Pahl-Wostl et al., 2008)

References (1/3)

- Ahern, Kenneth R, Daniele Daminelli, and Cesare Fracassi. “Lost in Translation? The Effect of Cultural Values on Mergers around the World.” *Journal of Financial Economics* 117, no. 1 (2015): 165–189.
- Alesina, Alberto, and Paola Giuliano. “Culture and Institutions.” *Journal of Economic Literature* 53, no. 4 (2015): 898–944.
- Atkin, David. “The Caloric Costs of Culture: Evidence from Indian Migrants.” *The American Economic Review* 106, no. 4 (2016): 1144–1181.
- Beresteanu, Arie, and Shanjun Li. “Gasoline Prices, Government Support, and the Demand for Hybrid Vehicles in the United States.” *International Economic Review* 52, no. 1 (2011): 161–182.
- Bezin, E. (2015). A cultural model of private provision and the environment. *Journal of Environmental Economics and Management*, 71:109-124.
- Bisin, Alberto, and Thierry Verdier. “The Economics of Cultural Transmission and the Dynamics of Preferences.” *Journal of Economic Theory* 97, no. 2 (2001): 298–319.
- Brounen, Dirk, and Nils Kok. “On the Economics of Energy Labels in the Housing Market.” *Journal of Environmental Economics and Management* 62, no. 2 (2011): 166–179.
- Chen, M Keith. “The Effect of Language on Economic Behavior: Evidence from Savings Rates, Health Behaviors, and Retirement Assets.” *The American Economic Review* 103, no. 2 (2013): 690–731.
- Costa, Dora L, and Matthew E Kahn. “Energy Conservation ‘Nudges’ and Environmentalist Ideology: Evidence from a Randomized Residential Electricity Field Experiment.” *Journal of the European Economic Association* 11, no. 3 (2013): 680–702.
- Gallagher, Kelly Sims, and Erich Muehlegger. “Giving Green to Get Green? Incentives and Consumer Adoption of Hybrid Vehicle Technology.” *Journal of Environmental Economics and Management* 61, no. 1 (2011): 1–15.

References (2/3)

- Gentili, Elena, Giuliano Masiero, and Fabrizio Mazzonna. "The Role of Culture in Long-Term Care Arrangement Decisions." *Journal of Economic Behavior & Organization* 143, no. Supplement C (2017): 186–200.
- Gifford, R. and Nilsson, A. (2014). Personal and social factors that influence pro-environmental concern and behaviour: A review. *International Journal of Psychology*, 49(3):141-157.
- Guiso, Luigi, Paola Sapienza, and Luigi Zingales. "Does culture affect economic outcomes?." *Journal of Economic perspectives* 20.2 (2006): 23-48.
- Egger, Peter H, and Andrea Lassmann. "The Causal Impact of Common Native Language on International Trade: Evidence from a Spatial Regression Discontinuity Design." *The Economic Journal* 125, no. 584 (2015): 699–745.
- Eugster, Beatrix, Rafael Lalive, Andreas Steinhauer, and Josef Zweimüller. "The Demand for Social Insurance: Does Culture Matter?" *The Economic Journal* 121, no. 556 (2011): F413–F448.
- Fearon, James D. "Ethnic and Cultural Diversity by Country." *Journal of Economic Growth* 8, no. 2 (2003): 195–222.
- Hofstede, G., Hofstede, G., and Minkov, M. (2010). *Cultures and Organizations: Software of the Mind*, Third Edition. McGraw-Hill Education.
- Hoyos, David, Petr Mariel, and Javier Fernández-Macho. "The influence of cultural identity on the WTP to protect natural resources: some empirical evidence." *Ecological Economics* 68.8-9 (2009): 2372-2381.
- Huse, Cristian, and Claudio Lucinda. "The market impact and the cost of environmental policy: evidence from the Swedish green car rebate." *The Economic Journal* 124.578 (2014): F393-F419.
- Kahn, Matthew E. "Do Greens Drive Hummers or Hybrids? Environmental Ideology as a Determinant of Consumer Choice." *Journal of Environmental Economics and Management* 54, no. 2 (2007): 129–145.

References (3/3)

- Kahneman, D., Ritov, I., and Schkade, D. A. (1999). Economic preferences or attitude expressions?: An analysis of dollar responses to public issues. *Journal of Risk and Uncertainty*, 19(1-3):203-35.
- Pahl-Wostl, Claudia, et al. "The importance of social learning and culture for sustainable water management." *Ecological economics* 64.3 (2008): 484-495.
- Shultz, Steven, Jorge Pinazzo, and Miguel Cifuentes. "Opportunities and limitations of contingent valuation surveys to determine national park entrance fees: evidence from Costa Rica." *Environment and Development Economics* 3.1 (1998): 131-149.
- Schumacher, I. (2009). The dynamics of environmentalism and the environment. *Ecological Economics*, 68(11):2842-2849.
- Schumacher, I. (2015). The endogenous formation of an environmental culture. *European Economic Review*, 76:200 - 221.
- Tjernström, Emilia, and Thomas Tietenberg. "Do differences in attitudes explain differences in national climate change policies?." *Ecological Economics* 65.2 (2008): 315-324.
- Videras, Julio, et al. "The influence of social relationships on pro-environment behaviors." *Journal of Environmental Economics and Management* 63.1 (2012): 35-50.
- Weber, Sylvain, et al. Swiss household energy demand survey (SHEDS): Objectives, design, and implementation. No. 17-14. IRENE Institute of Economic Research, 2017.
- Welsch, Heinz, and Jan Kühling. "Determinants of pro-environmental consumption: The role of reference groups and routine behavior." *Ecological economics* 69.1 (2009): 166-176.
- Wilhite, Harold, et al. "A cross-cultural analysis of household energy use behaviour in Japan and Norway." *Energy policy* 24.9 (1996): 795-803.

Appendix

Robustness Checks

Table 2: Panel Model, Energy Label

	(1)	(2)	(3)	(4)	(5)
<i>Share of A- and B-label vehicles</i>					
Share French	0.041*** (0.004)	0.035*** (0.004)	0.031*** (0.004)	0.031*** (0.004)	0.035*** (0.004)
Observations	11,006	11,006	9,171	9,171	2,640
R ²	0.746	0.769	0.772	0.774	0.826
Controls	No	Yes	Yes	Yes	Yes
Time Variant Controls	No	No	Yes	Yes	Yes
Mundlak Correction	No	No	No	Yes	Yes
Sample	all CH	all CH	all CH	all CH	*Bilingual

*Bilingual Cantons: Bern, Valais and Fribourg

Canton-time dummies and Controls in all models

Municipality clustered standard errors in parentheses

***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.10$

Appendix

Robustness Checks

Table 4: RDD CO2 - 2nd Stage

		(1)	(2)	(3)	(4)	(5)
<i>Median CO2 Emissions per Municipality</i>						
2008	Share French	-7.257*** (1.260)	-7.913*** (1.466)	-5.413** (2.133)	-5.358*** (2.035)	-5.316*** (1.893)
	Observations	1,833	528	749	351	351
	R ²	0.534	0.459	0.473	0.408	0.569
2009	Share French	-7.416*** (1.245)	-7.857*** (1.484)	-5.771*** (2.053)	-5.254*** (1.913)	-5.011*** (1.806)
	Observations	1,833	528	749	351	351
	R ²	0.546	0.453	0.477	0.407	0.584
2010	Share French	-6.696*** (1.401)	-6.896*** (1.677)	-5.947*** (2.287)	-4.708** (2.174)	-4.814*** (1.803)
	Observations	1,835	528	751	353	353
	R ²	0.539	0.442	0.441	0.350	0.562
2011	Share French	-7.044*** (1.329)	-6.852*** (1.532)	-7.929*** (2.243)	-5.055** (2.064)	-5.011*** (1.650)
	Observations	1,835	528	751	353	353
	R ²	0.528	0.455	0.446	0.403	0.621
2012	Share French	-6.766*** (1.286)	-6.690*** (1.561)	-7.704*** (2.431)	-5.316** (2.220)	-5.316*** (1.896)
	Observations	1,835	528	751	353	353
	R ²	0.508	0.447	0.430	0.410	0.611
Bandwidth		all CH	*Bilingual	50 km	25 km	25 km
Polynomial		Quadratic	Quadratic	Quadratic	Linear	Linear
Covariates		No	No	No	No	Yes

*Bilingual Cantons: Bern, Valais and Fribourg

Canton FE and control variables in all models

Heteroskedasticity Robust standard errors in parentheses

***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.10$

Appendix

Robustness Checks

Table 5: RDD Fuel Economy - 2nd Stage

		(1)	(2)	(3)	(4)	(5)
<i>Median Fuel Consumption per Municipality</i>						
2008	Share French	-0.309*** (0.054)	-0.336*** (0.062)	-0.232** (0.091)	-0.236*** (0.086)	-0.232*** (0.078)
	Observations	1,833	528	749	351	351
	R ²	0.554	0.469	0.488	0.447	0.587
2009	Share French	-0.315*** (0.054)	-0.355*** (0.065)	-0.296*** (0.091)	-0.268*** (0.085)	-0.259*** (0.078)
	Observations	1,833	528	749	351	351
	R ²	0.555	0.445	0.489	0.438	0.598
2010	Share French	-0.300*** (0.060)	-0.322*** (0.070)	-0.299*** (0.099)	-0.231** (0.094)	-0.239*** (0.079)
	Observations	1,835	528	751	353	353
	R ²	0.530	0.423	0.439	0.372	0.571
2011	Share French	-0.271*** (0.056)	-0.264*** (0.065)	-0.303*** (0.095)	-0.198** (0.089)	-0.197*** (0.071)
	Observations	1,835	528	751	353	353
	R ²	0.488	0.395	0.404	0.356	0.581
2012	Share French	-0.251*** (0.053)	-0.253*** (0.065)	-0.305*** (0.103)	-0.211** (0.093)	-0.216*** (0.081)
	Observations	1,835	528	751	353	353
	R ²	0.473	0.384	0.384	0.362	0.562
Bandwidth		all CH	*Bilingual	50 km	25 km	25 km
Polynomial		Quadratic	Quadratic	Quadratic	Linear	Linear
Covariates		No	No	No	No	Yes

*Bilingual Cantons: Bern, Valais and Fribourg

Canton FE and control variables in all models

Heteroskedasticity Robust standard errors in parentheses

***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.10$

Appendix

Robustness Checks

Table 6: Non-parametric fuzzy RDD

	(1)	(2)	(3)	(4)	(5)
RD Estimate	0.070*** (0.004)	0.080*** (0.008)	0.060*** (0.008)	0.053*** (0.014)	0.039* (0.020)
Observations	565	179	329	179	135
Bandwidth	all CH	*Bilingual	50 km	25 km	**15.85 km

Data from 2010; *Bilingual Cantons: Bern, Valais and Fribourg

**Optimal bandwidtht using the stata package rdrobust

Standard errors in parentheses, uniform kernel

***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.10$

Appendix

Robustness Checks

Table 7: Linear Probability RDD with Individual Data

	(1)	(2)	(3)	(4)	(5)
<i>A-or B-Label Vehicle</i>					
Share French	0.039*** (0.009)	0.081*** (0.019)	0.092*** (0.015)	0.052*** (0.010)	0.047*** (0.008)
Observations	3,767,790	821,242	1,232,560	496,567	378,896
R ²					
Bandwidth	all CH	*Bilingual	50 km	25 km	25 km
Polynomial	Cubic	Cubic	Quadratic	Linear	Linear
Covariates	No	No	No	No	Yes

*Bilingual Cantons: Bern, Valais and Fribourg

Data from 2010; Canton FE in all models, covariates include car brand

Municipality clustered standard errors in parentheses

***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.10$

Appendix Graphs

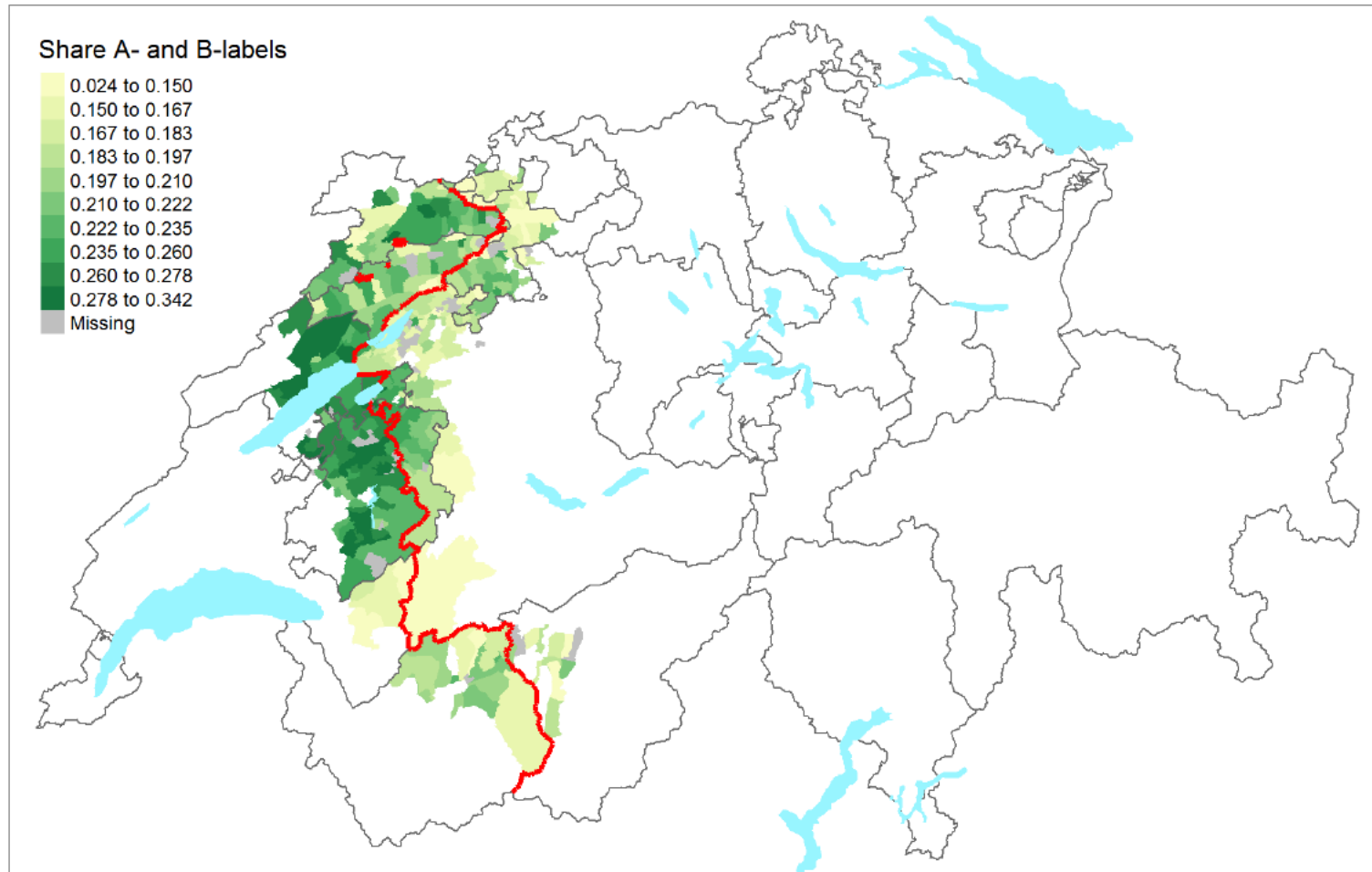


Figure 4: Share of A and B label vehicles, 25 km from language border (in 2010)

The language border is marked in red

Source: MOFIS/TARGA dataset

Appendix Graphs

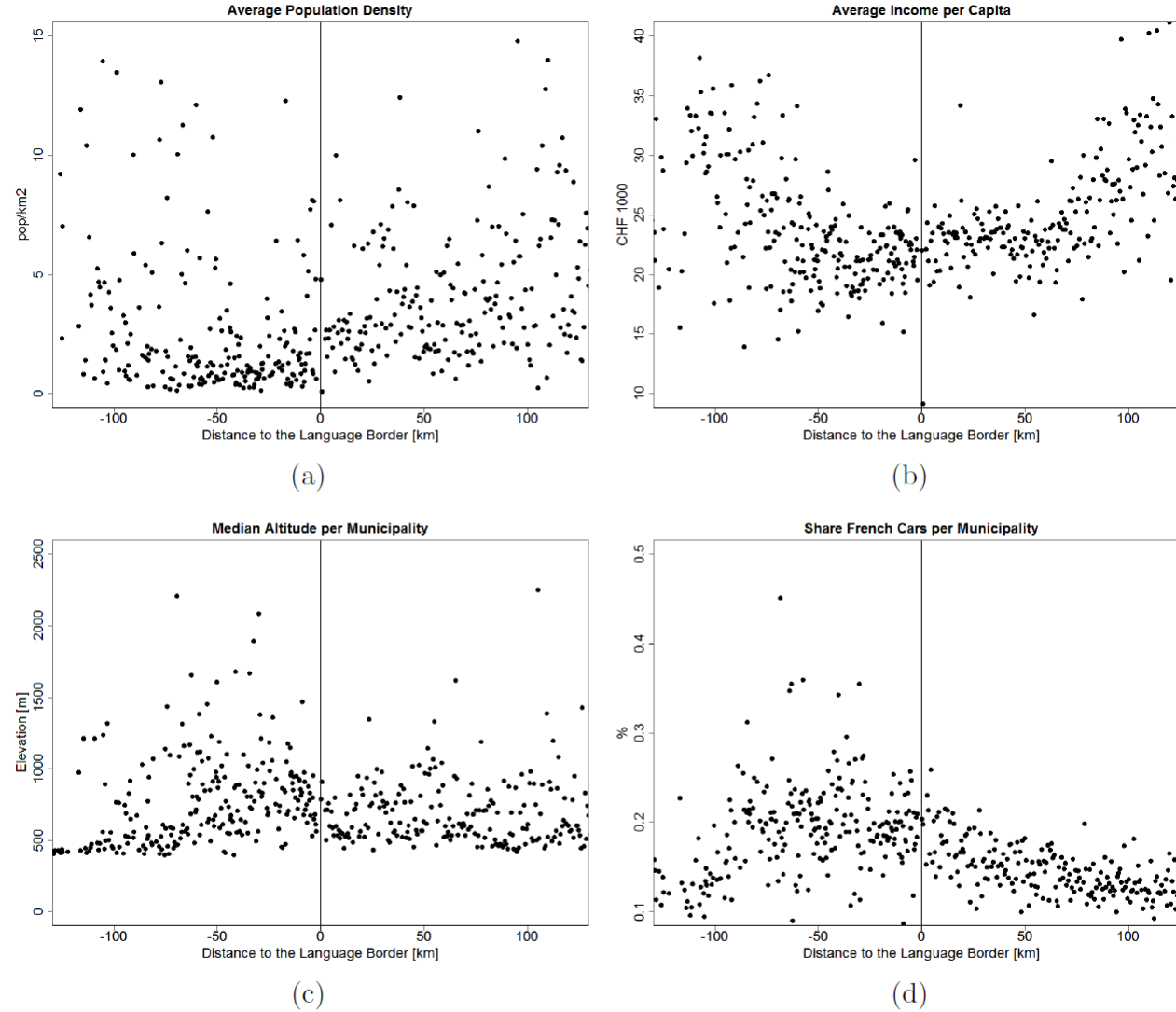


Figure 7: Mean Population Density, Income per Capita and Altitude (in 2010)
Source: BFS and ARE

Appendix Graphs

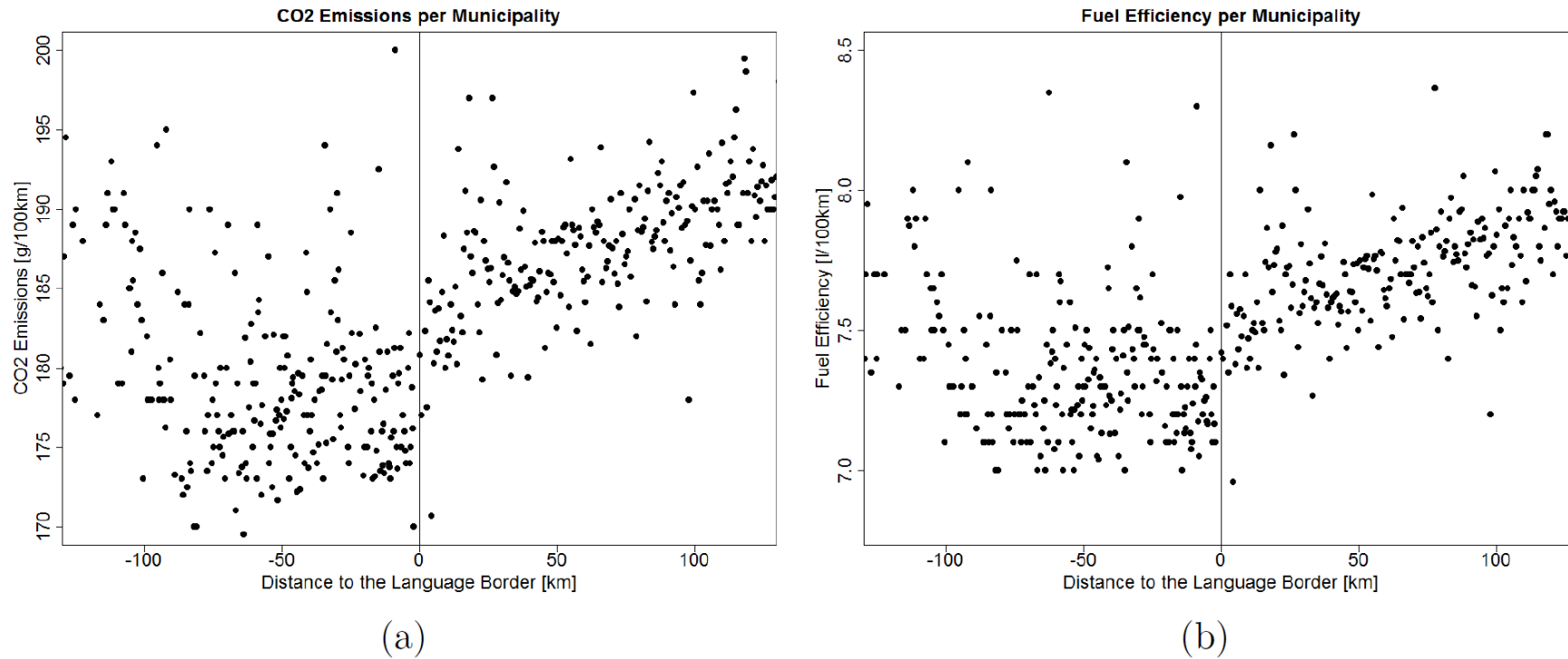


Figure 6: CO₂ Emissions and Fuel Efficiency (in 2010)
Source: BFS and ARE