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# The Effect of Culture on Energy Efficient Vehicle Ownership

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**Abstract**

Does culture affect consumer preferences for fuel efficient vehicles? Switzerland's citizens share all major institutions but belong to multiple population groups which differ by culture or language across distinct geographical locations. This unique setting allows separation of the effect of culture on institutions and on individual consumer preferences. We set up a spatial fuzzy Regression Discontinuity Design (RDD) at the internal French/German language border to estimate the effect of culture on preferences for energy efficient design and control for local policies. A within-country analysis on the municipality level provides a natural experiment because institutions relevant to economic development are shared by the whole population, whereas culture is heterogeneous. Our results indicate that in French speaking regions of Switzerland the share of energy efficient vehicles is 5.5 percentage points higher than in German speaking regions. In addition, we find that popular votes on environmental issues receive a significantly higher share of approval in the French speaking regions, indicating that they place a higher value on the environment.

**Keywords:** Culture, Transportation, Energy Efficiency, Spatial RDD, Car Choice

**JEL Classification Codes:** Q2, Q4, R4, Z10

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# 1 Introduction

In the context of increasing attention to energy efficiency in environmental economics, there is evidence that economic incentives are not the only motivation for consumers' decisions on energy saving. A growing literature suggests that culture is an important factor in economic decision making, for instance in explaining saving rates (Guiso et al., 2006) or pursuing business relations (Ahern et al., 2015). Following (Guiso et al., 2006), we define culture as *"customary beliefs and values that ethnic, religious, and social groups transmit fairly unchanged from generation to generation"*. We believe there is strong evidence that culture also influences environmental decisions: in this study, we document differentiated patterns of energy efficient vehicle ownership in Switzerland and propose that culture is one important explanatory factor. Switzerland's citizens share all major institutions but belong to multiple population groups which differ by culture or language across distinct geographical locations. This unique setting allows us to separate the effect of culture on institutions and on individual consumer preferences.

The role of culture is increasingly present in the economics literature: Bisin and Verdier (2001) suggest that culture has a direct impact on individual preferences and both Fehr and Hoff (2011) and Hoff and Stiglitz (2016) advocate the use of culture as an endogenous determinant of economic preferences. The application of culture can be observed in major economic fields: Guiso et al. (2006) suggest that "cultural variables are as important as economic variables in understanding cross-country differences in national savings rates"; Ahern et al. (2015) find that "the volume of cross-border mergers is lower when countries are more culturally distant" [in trust, hierarchy and individualism] and Guiso et al. (2009) propose that cultural similarities between countries affect trust which increases bilateral trade and direct investments. Giannetti and Yafeh (2012) argue that banks require higher interest rates to culturally distant borrowers and require more frequently third-party guarantees; Atkin (2016) suggests that cultural preferences for traditional foods can constrain caloric intake and contribute to malnutrition among migrants.

The objective of this paper is to analyze the impact of culture on consumer preferences for energy efficient cars. To do this, we can hardly rely on a cross-country comparison. In fact, with the use of cross-country data it is difficult to identify the effect of culture, since culture is often used to explain the structure of institutions, which, in return, determine economic differences between societies. For instance, Alesina and Giuliano (2015) argue that culture and institutions are both complements and interact in their impact on economic development. From an empirical point of view, it is important to use an identification strategy that allows us to disentangle the impact of culture from the impact of institutions on the adoption of energy efficient vehicles. Such an identification strategy would be to analyze the behavior of consumers with different cultural backgrounds that live in the same region.

This paper will develop an analysis of several cultural groups within one country, where most political and other institutions are homogeneous and therefore the variation in their impact is limited. A within-country analysis provides a natural experiment because institutions relevant to economic development are shared by the whole population, whereas culture is heterogeneous. The analysis will also take into account the impact of local (cantonal[1]) norms and institution on fuel efficient vehicles and provide an estimator for the impact of culture, robust to regional specific effects.

In environmental economics, culture is not explicitly mentioned as in the literature presented above: Turrentine and Kurani (2007) suggest, using interviews, that the value of fuel economy goes beyond cost saving and has a symbolic value to consumers. Furthermore, Sexton and Sexton (2014) find evidence for willingness to pay for a hybrid vehicle as a status symbol. Goldberg and Verboven (2001) suggests that consumers have a home bias for domestically produced cars and Knight (1999) finds evidence that consumers prefer to buy cars of domestic origin because of cultural affinities. Schindler and Holbrook (2003) propose that childhood conditioning influences consumer preferences for cars. In addition, there exists a literature on "ideological" influences on consumer decisions: Brounen and Kok (2011) find that green party voters are more likely to adopt energy labels for the

[1] Switzerland's regional administration is organized in 26 Cantons

housing market and Costa and Kahn (2013) suggest that nudging on electricity consumption is two to four times more effective with liberals that with conservatives. Kahn (2007) shows that the sales of hybrid and fuel efficient vehicles depend on the share of green party members, which are used as a proxy for environmentalism. Gallagher and Muehlegger (2011) confirm those results by taking Sierra Club membership as a proxy for environmentalism. Quantitative analysis of cultural preferences, as defined by Guiso et al. (2006), for cars in general, and with respect to the role of energy efficiency in particular, has received little attention up to now.

The empirical identification of the impact of culture on the adoption of energy efficient cars is based on a regression discontinuity approach. Specifically, to estimate the effect of culture on vehicle choice and culture on environmentalism, independently of institutions, we will conduct a spatial Fuzzy Regression Discontinuity Design (RDD) at the internal Swiss language border. Several studies have used language as a proxy for variation in culture and as a determinant of economic outcomes, e.g. Fearon (2003), Desmet et al. (2012), Chen (2013) or Falk et al. (2017). In a similar setting, and using a RDD approach, Eugster et al. (2011) describe the effect of culture on the demand for social insurance in Switzerland via differences in popular voting results, Egger and Lassmann (2015) show the effect of culture on international trade at the internal Swiss language border, and Gentili et al. (2017) analyze the effect of culture on decision making concerning elderly care.

Our results show that the population living in the French speaking parts of Switzerland owns a higher share of fuel efficient cars than the German speaking population. The difference in fuel efficiency is the result of different vehicle characteristics, mainly curb weight, number of diesel engines and replacement rate. Moreover, popular votes on environmental issues receive a higher share of approval in the French speaking part of Switzerland, indicating a different level of concern for the environment.

The paper is organized as following: the next section explains how language can be used as a proxy for culture in Switzerland. Section 3 provides the empirical strategy used in our analysis and evaluates the necessary conditions. In section 4 we explain the data used for vehicle and municipality characteristics. Our main results are presented and analyzed in section 5. In the final section we will present the conclusions, followed by an appendix containing robustness checks and graphs.

## 2 Languages as a proxy for culture

The literature strongly suggests that language can be used as a proxy for culture: Parsons et al. (1965) define culture as a *"set of symbols of communication"* which means that language is a medium for culture and at the same time an identifier of a specific culture. In linguistics, the meaning of language goes beyond that of a medium for culture: it also shapes the speaker's cognition of the world, making it an active consituent of a culture according to the concept of "Linguistic Relativity" (Whorf, 1997). In the economics literature, Chen (2013) explains differences in saving rates in Switzerland by the linguistic structure of the German and French language.

Switzerland consists of four language groups (German, French, Italian and Romansh) each of which occupy a distinct geographical area of the Swiss territory. According to the 2000 census, 72.5% of the population is German speaking, 21% French, 4.3% Italian and 0.6% Romansh, with a total population of $\sim$ 8 million[2]. Figure 1 depicts the distribution of the main language per municipality according to the 2000 census (data from the Swiss Federal Statistical Office (BFS)). The map shows a clear spatial separation of the German and French speaking municipalities, where the red line depicts the language border, the so-called "Röstigraben". Italian and Romansh-speaking areas are separated by the Alps from the German speaking part of Switzerland. In the empirical analysis of this paper, we consider the language border between the German speaking and the French speaking municipalities. We exclude the language border between the Italian/Romansh speaking areas and the German speaking regions because the Alps represent an important

[2]A comparison with language data collected and merged from four microcensuses from 2011-2015 shows no significant change in the spatial distribution of the native language. Therefore, the spatial distribution of people speaking Italian, French, German or Romansh remains constant over time. We choose to use the language data from the census of the year 2000, because the microcensuses omit a small number of very small municipalities.

natural barrier between the language regions. In contrast, the German-French language border is not defined by geographical obstacles: the language border runs along the North-South axis of Switzerland, whereas the major geographical obstacle in Switzerland, the Alps, follow the East-West axis.

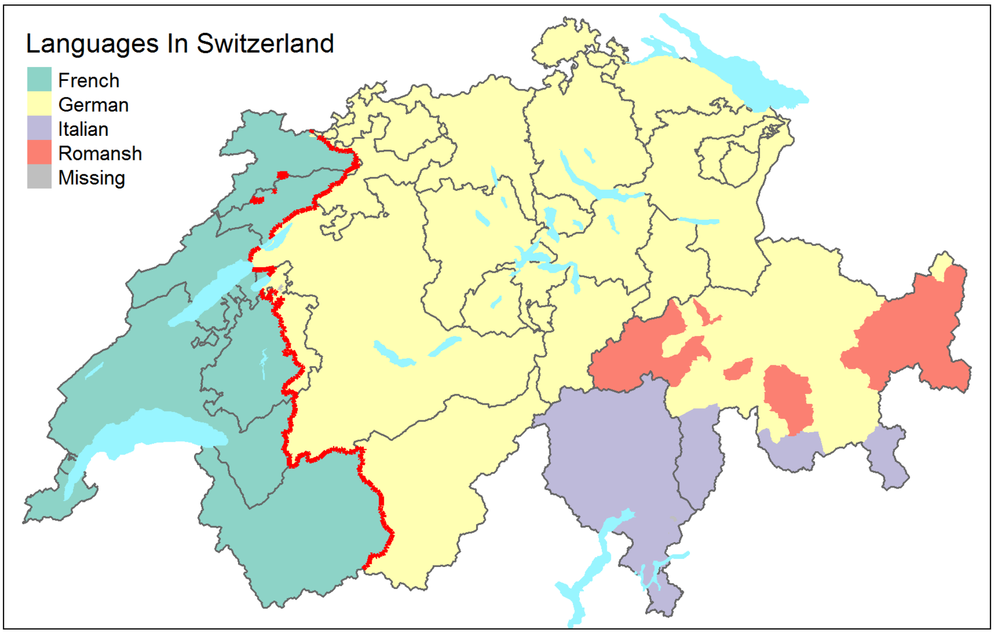



Figure 1: Languages in Switzerland
Source: BFS Census 2000

The Swiss Confederation was founded in 1291 when the Central Swiss Cantons seceeded from the German Empire and was successively enlarged over the following centuries. Modern Switzerland dates back to 1848, when the Swiss Constitution established a Federal State composed of 26 Cantons: 18 German speaking, four French speaking, three bilingual (German-French), one trilingual (Graubünden with German, Italian and Romansh).

In order to visualize the spatial distribution of French speakers in Switzerland, we plot the share of French speakers per municipality and the distance per municipality to the language border in Figure 2: as expected, municipalities located in the French regions show a high share of French speakers. Although there are no natural obstacles at the German-French language border, the share of native French speakers at the border is very high, which results in a clear cut language-border (see Figure 2).

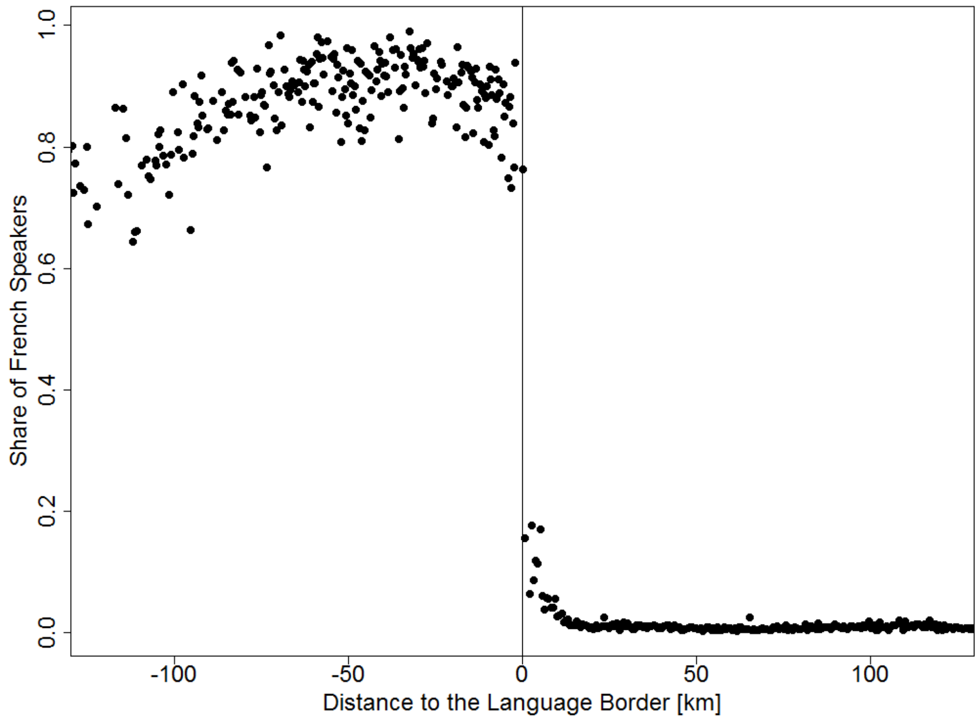



Figure 2: Share of French speakers in relation to distance to language border (in 2010)

Source: MOFIS/TARGA dataset

Assimilation and integration processes ensure a dominance of the respective culture in its realm. The persistence of the respective native language in each region indicates that aside from the native population, immigrants either come from the same language area (France or Germany) or adopt the dominant native language in the second generation. In addition, Novembre et al. (2008) found that genetic markers between people living in the French and Germanic area of Switzerland show a higher variation between than within those regions, which indicates that individuals are more likely to start a family with a partner of their own language group. In this context, we can assume that language is a proxy for culture: values, beliefs and attitudes are transmitted within groups, which are defined by their common native language.

# 3 Empirical Strategy

From the econometric point of view, the impact of culture on the adoption of energy efficient cars is analyzed using two approaches, a panel regression and a RDD. First, we conduct a linear panel regression analysis using the basic version of the Mundlak correction (Mundlak, 1978) to correct for time-invariant unobserved heterogeneity. We use the following model:

$$Y_{it} = \beta_0 + \beta_1 language_i + \beta_2 X_{it} + \beta_3 \bar{X}_i + \epsilon_{it} \quad (1)$$

where $Y$ is the share of energy efficient cars in municipality $i$ in year $t$. "*language*" is the share of French speakers in the year 2000, $X_{it}$ is a set of socio-economic variables at the municipality level containing the share of cars by French producers, income per capita, population density, elevation and a dummy for urban areas. $\bar{X}_i$ is the average over time of $X_{it}$ (naturally, elevation is constant over time)

Second, we adopt a spatial fuzzy RDD using the distance of each municipality to the language border. Of course, the RDD is our preferred identification strategy. In this setting at the proximity of the language border, a regression on efficient vehicle ownership and language will show the average treatment effect of culture. We use a fuzzy RDD because unlike in a sharp RDD, and as shown in Figure 2, the probability of treatment (speaking French) does not change from zero to one but rather from 0.04 to 0.85, with small differences in each municipality.

An important step in the application of this approach is to first visually analyze the level of discontinuity of the dependent variable, the share of energy efficient cars at the proximity of the language border. The level of energy efficiency of a car can be measured by different indicators, such as $CO_2$ emissions, fuel efficiency or a system of energy labels. In Switzerland, the government has introduced energy efficiency labels for cars that are relative to curb weight, and where A- and B-labels represent the most energy efficient cars. In our study, we consider this label system as the most informative variable for the Swiss consumers. Therefore, the dependent variable in eq (1) is the share of A- and B- label vehicles. In Figure 3, we represent the distribution of municipalities with their share of cars with an A- or B-label and can see a discontinuity at the language border. This observation is confirmed in Figure 6 (Appendix), where we represent the distributions of municipalities with their values for average $CO_2$ emmisions and average fuel consumption per car.

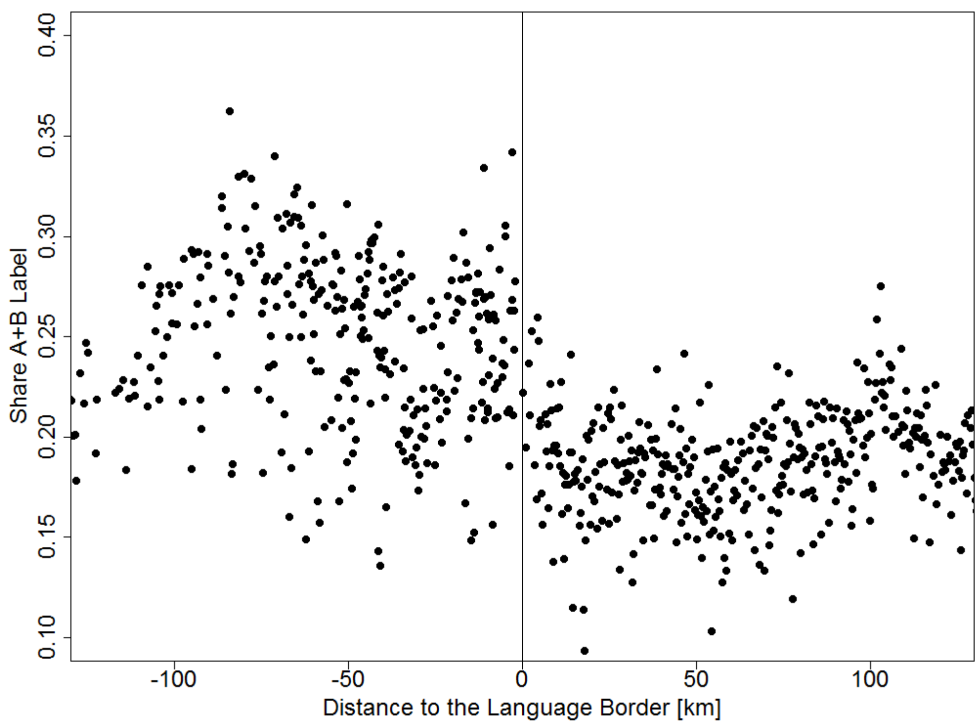



Figure 3: Share of A and B labels in relation to distance to language border (in 2010)

Source: MOFIS/TARGA dataset

The empirical analysis is based on the estimation of a regression that uses only data within a selected bandwidth above or below the cut-point. In this context, the choice of bandwidth is crucial and has to trade off between opposing criteria: a larger bandwidth contains more precision-increasing observations, whereas a smaller bandwidth minimizes bias.

In order to use a RDD approach, three conditions should be fulfilled (Lee and Lemieux, 2010). First, the running variable to determine the discontinuity must be continuous. In this case the running variable is the distance to the language border in km, which is continuous. Second, agents should not be able to precisely control whether they receive the treatment or not. This condition is fulfilled in our setting, since the native language is not a choice an individual can make and native language is used as a proxy for culture. Third, covariates must be balanced at the discontinuity or vary smoothly. Importantly, there should be no discontinuous change at the language border in order to have no correlation of the covariates with the treatment.

The classical and most important explanatory variables used in the empirical literature to explain the demand for cars are income per capita, population density, topography, fuel prices and policy measures such as fuel economy standards and subsidies. Johansson and Schipper (1997) find that income, fuel price, population density and national fuel economy standards have a positive impact on the adoption of fuel efficient vehicles. Small and Van Dender (2007) obtained similar results, although income shows no statistical significance. Similarly, Klier et al. (2010) and Beresteanu and Li (2011) estimate the volume of hybrid car sales in the US by using standard economic variables which reflect price sensitivity. Both studies find a positive impact of fuel price on fuel intensity. In addition, Beresteanu and Li (2011) suggest a lower price sensitivity of high income consumers, a positive impact of large households with children as well as consumers living in urban areas on the sales volume of hybrid vehicles. More recent findings by Heutel and Muehlegger (2015) confirm earlier results. Moreover, Allcott and Knittel (2017) conclude after two experimental studies that imperfect information and inattention do not explain consumer choices with respect to fuel economy. For Switzerland, we can also assume that geographical differences such as altitude could also play a role. Some of these proposed variables could show variation at the regional level, whereas others not. For instance, fuel economy standards do not differ within Switzerland, and the price for cars, the price for fuel and the quality of the public transportation system are generally homogeneous at the regional level.

As discussed previously, in a RDD, those factors have to be independent of the treatment variable (culture) in order to isolate its effect. Therefore, we examine, using figures and computing statistics, the variation at the language border of the most important explanatory variables. Figure 7 (Appendix) shows that in 2010 most of the socio-economic covariates do not show a discontinuity except altitude. Even if we can observe a slight mean difference in the population density, the variance in this variable is high, which suggests that the mean difference (and thus the discontinuity) is not significant. The share of cars by French producers does not show a discontinuity at the language border, which implies that the French speaking population does not have a preference for French cars. Altitude does show a difference at the language border, this difference however is not sustained throughout all Switzerland.

Table 1 compares the mean difference of outcome variable, treatment and controls at a narrow range of 25km from the language border with a t-test for the year 2010[3]. The results confirm the intuition given by the graphs in the figures 2, 3, 6 and 7 (Appendix), that outcome and treatment change discontinuously whereas most of the controls do not. The difference between the French and German speaking regions is evaluated using Welch's t-test and a non-parametric, sharp RDD (using the driving distance to the language border as running variable). In comparison to the t-test, the RDD is more restrictive: while the difference in language and the share of labels remain significant under the RDD, the difference in $CO_2$ emissions, fuel economy and the share of French cars does not. Municipality elevation does show a significant difference at a bandwidth of 25km, throughout the entire dataset there are however not two clearcut groups as with language. Moreover, Filippini et al. (2015) showed that elevation is associated with higher fuel consumption,

[3]With our choice of bandwidth we closely follow Eugster et al. (2011)

which means in our context that omiting elevation from the model would lead to an overestimation of the effect of culture.

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

| | mean French | mean German | Difference | RDD Estimate |
|---|---|---|---|---|
| Share French | 0.87 | 0.03 | 0.84*** | 0.71*** |
| | (0.08) | (0.06) | | (0.02) |
| Share A- and B-Label | 0.24 | 0.18 | 0.06*** | 0.04*** |
| | (0.05) | (0.04) | | (0.01) |
| Median $CO_2$ Emissions | 177.97 | 184.35 | -6.38*** | -1.37 |
| | (6.95) | (7.97) | | (1.67) |
| Median Fuel Econ. | 7.3 | 7.58 | -0.28*** | -0.06 |
| | (0.3) | (0.36) | | (0.07) |
| Income/Capita | 23.2 | 23.84 | -0.64 | -0.03 |
| | (3.22) | (4.68) | | (1.02) |
| Population Density | 2.59 | 3.34 | -0.75 | 0.36 |
| | (4.39) | (5.46) | | (1.41) |
| Elevation | 814.26 | 657.73 | 156.53*** | 207.48*** |
| | (310.76) | (351.03) | | (67.55) |
| Quality Pub. Transport | 0.16 | 0.16 | 0 | -0.04 |
| | (0.37) | (0.36) | | (0.08) |
| Share Urban | 0.02 | 0.01 | 0.01 | 0 |
| | (0.14) | (0.08) | | (0.03) |
| Share French Cars | 0.2 | 0.18 | 0.02*** | 0.01 |
| | (0.06) | (0.06) | | (0.02) |
| Green-Party 2011 | 9.76 | 10.46 | -0.7 | 0.43 |
| | (4.01) | (4.52) | | (1.1) |
| Green-Party 2015 | 8.75 | 8.95 | -0.2 | -0.63 |
| | (3.61) | (4.01) | | (1.05) |

The RDD was implemented with the package rdrobust, using a sharp, non-parametric design with a bandwidth of 25km and a uniform kernel
$N_{Total}$: 317, $N_{French}$: 151, $N_{German}$: 166
Standard deviations/errors in paranthesis
***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.10$

Source: MOFIS/TARGA dataset and BFS

The map in Figure 4 highlights the area at a distance of 25km from the language border. Not all municipalities at the language border are highlighted in the map because the relevant measure is the street distance to the border. Some municipalities, even though they are located at the border, are in mountainous regions which means that their driving distance to the next municipality exceeds 25km.

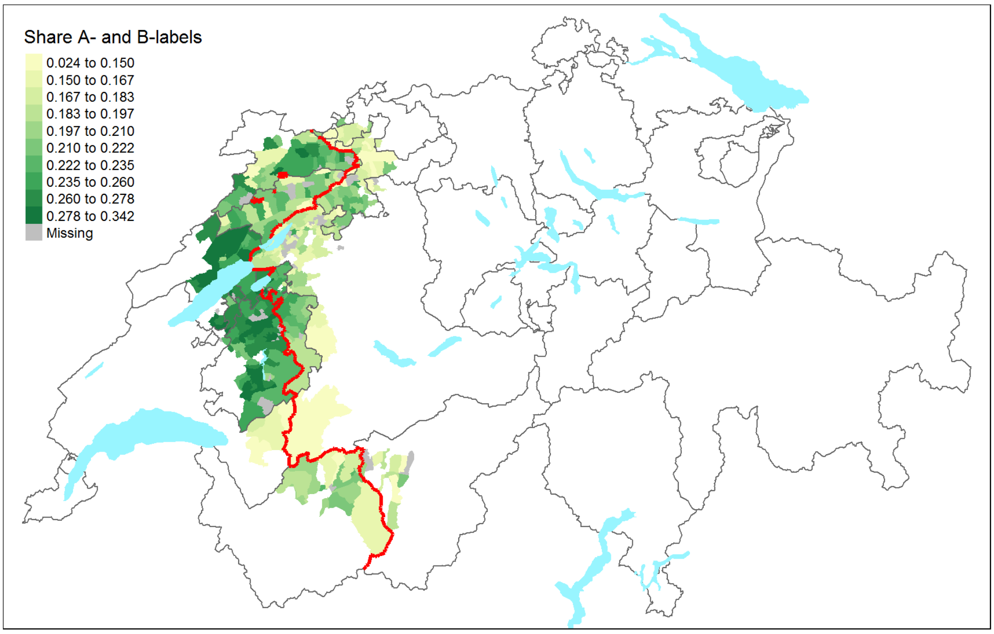



Figure 4: Share of A and B label vehicles, 25 km from language border (in 2010)
The language border is marked in red
Source: MOFIS/TARGA dataset

In the fuzzy RDD we estimate a standard cross section model and add the distance of each municipality to the language border as well as the interaction term of language and distance. In a second step, we subsequently decrease the bandwidth (i.e. distance to the language border) in order to minimize the effect of structural factors other than language. Both models use a 2SLS approach to implement the fuzzy RDD. In the first stage, we use a dummy indicating whether the municipality is located in the French-speaking region, as an instrument for the percentage of French-speakers. The second stage of the cross section fuzzy RDD is specified as follows:

$$
\begin{aligned}
Y_i = \beta_0 + \beta_1 language_i + \beta_2 F_{i,fr} + \beta_3 F_{i,fr}^2 + \beta_4 F_{i,ger} \\
+ \beta_5 F_{i,ger}^2 + \beta_6 X_i + \epsilon_i
\end{aligned}
\tag{2}
$$

where $Y$ is the share of A and B-labeled vehicles in municipality $i$. "*language*" is the share of French-speakers, $F_i$ is the distance of the municipality to the lanugage border for French speaking municipalities or for German speaking ones (this specifications allows for different slopes on either side of the language border). $F$ is a j-th degree polynomial of the distance to the language border. $X_i$ contains a set of socio-economic variables at the municipality level: the share of cars by French producers, income per capita, population density, elevation and a dummy for urban areas.

# 4 Data Description

For the analysis, we use data on individual vehicle registration in Switzerland from 2008 to 2012, the share of French native speakers per municipality, the distance of each municipality to the language border and a set of covariates. Information on the share of energy efficient vehicles (cars with A and B labels, $CO_2$ emissions and level of fuel efficiency) at the municipality level has been obtained from a data set created at the Center for Energy Policy and Economics at the ETH Zurich. [4]

We use income data from the Swiss Federal Tax Administration on the direct federal tax. As income we use the total taxable net revenue per municipality for natural persons, measured in thousand CHF. In addition to natural persons. Population data was obtained from the BFS, using the balance of permanent residents by districts and municipalities, where the population for each year is the mean of the population at the beginning and at the end of the year, measured in 1000s of inhabitants. The area of each municipality was obtained from the areal statistics of Switzerland 2004/09 from the BFS and is measured in ha. Altitude is measured in meters above sea level and depicts the median value per municipality, obtained from the BFS. Data on the quality of Public Transportation in 2010 was obtained from the Federal Office for Spatial Development (ARE). Results from the 2011 federal election were obtained from the BFS and are given in percentage points. The language statistics contain the number of native speakers of each language per municipality, according to the census of the year 2000. The data was obtained from the BFS and municipality mergers were performed retroactively.[5]

In order to measure the distance of each municipality to the language border, we use a matrix of street distances between all Swiss municipalities (from center to

[4] Relevant information about this dataset can be found, together with further information, in Alberini et al. (2015).

[5] Between Jan 1. 2000 and Jan 1. 2017, several municipalities were merged in Switzerland. Details about the mergers can be found at the BFS under "Amtliches Gemeindeverzeichnis der Schweiz". In the income, population and area datasets, the mergers were performed retroactively by aggregating the concerned municipalities and assigning them a new municipality code.

center), originating from Search.ch[6]. Similarly to Eugster et al. (2011) the municipalities were attributed to a single language group (French or non-French): we determined a total of 29 French speaking municipalities constituting the border towns to the German speaking region. Since those municipalities constitute the language border, the distance of a border-municipality $i$ to the language border $F$ is $F_i = 0$. In a second step, we calculate the distance of all other municipalities to the nearest border town (center to center) and multiply the distance by $(-1)$ if the municipality is located in the French region. As a result, French municipalities either have a distance of zero if they constitute the border or a negative distance. German speaking municipalities have a positive distance to the language border. As the distance data dates from the year 2010, we took into account municipality mergers until Jan 1st 2017 by taking the average distance of the municipalities concerned by mergers.

[6] The dataset was kindly provided by Beatrix Eugster and Raffael Lalive (University of St. Gallen and Lausanne) and corresponds to the data used in Eugster et al. (2011)

As described previously, we omit the Italian speaking cantons of Tessin and Graubünden in order to compare two distinct language groups, French- and German-speaking. The final dataset contains data on 1836 municipalities from 2008 to 2012 (9171 observations). 87 municipalities were omitted from the dataset due to missing values. In the RDD we will select all municipalities located within a distance of 25km to the language border: the RDD sample contains 353 municipalities which are in the cantons Bern, Fribourg, Solothurn, Basel-Landschaft, Vaud, Valais, Neuchatel and Jura. Some cantons imposed a label policy in order to promote energy efficient labels. Among the previously mentioned cantons this concerns the canton of Fribourg, however the language border runs through the canton of Fribourg, which means that a possible effect of the label policy would not manifest itself in the magnitude of the language treatment.

# 5 Results

In Table 2 we report the estimation results from the basic regression model. These indicate a strong relationship between culture and the share of vehicles with A and B labels. All model specifications include year- and canton Fixed Effects. Therefore, this specification should be able to to control for any Cantonal policy measures. Column (1) shows the model without any covariates, results under this specification are less robust than with covariates, as in column (2) and (3), which suggest that the covariates control for a source of unobserved heterogeneity. In column (4) we show the model with the Mundlak correction that controls for time-invariant unobserved heterogeneity. The estimator for *language* does not change significantly with the Mundlak extension, which suggests that the treatment effect is neither correlated with the covariates nor any time-invariant unobserved heterogeneity. Furthermore, a reduction of the sample to the three bilingual Cantons in column (5) (Bern, Fribourg and Valais) shows no change in the treatment effect either.
Table 3 presents the results of the influence of language on vehicle choice, obtained using a fuzzy RDD. All model specifications include Canton Fixed Effects. Therefore, this specification should be able to to control for any Cantonal policy

measures. In column (1) we use the entire sample with a quadratic polynomial, column (2) restricts the estimation to the three bilingual cantons, with little effect on the results. Further, in column (3) to (5), we use different bandwidths and in columns (4) and (5), we use a linear model instead of a second degree polynomial. Column (5) also includes covariates (income per capita, population density, elevation, share of french cars and an urban dummy), which do not significantly influence the result compared to column (4). The estimation results for each year suggest a strong effect of culture on efficient vehicle choice. Throughout the period from 2008 to 2012, the effect of culture appears to increase every year. With increasing distance the effect increases throughout all years and the standard errors of the coefficient decrease.[7]
As expected, the *language* coefficient decreases and the standard error increases as the bandwidth becomes more narrow. Therefore a simple estimation using the entire Swiss dataset would overestimate the effect of language, due to unobserved heterogeneity which is eliminated with the RDD. Overall, the treatment effect of language is of a magnitude of about 5.5 percentage points. Compared to the total mean difference at the language border of 6.2 percentage points[8], cultural preferences account for 88% of the difference between the two regions.

The magnitude of the results is comparable to several policies on fuel efficiency: Huse and Lucinda (2014) find that in Sweden a rebate of SEK 10000 (about USD 1200) for energy efficient vehicles increases their market share by 5.5 percentage points. Beresteanu and Li (2011) show that a US federal income tax deduction of up to USD 2000 for hybrids explains 5% of sales. Gallagher and Muehlegger (2011) find that a 1000$ tax incentive for hybrid vehicles increases sales by 3% if the incentive is allocated on federal income taxes and a 45% increase in case of a sales tax rebate; Chandra et al. (2010) associates a 34% increase in sales with a CAD 1000 sales tax rebate on hybrids in Canada. Moreover, Gallagher and Muehlegger (2011) propose that an additional 100$ of annual fuel savings, associated with hybrids, results in 13% more hybrid sales, a 10% gasoline price increase leads

[7] note that the effect of the bandwidth is non-linear

[8] In the French speaking part of Switzerland, the mean share of A- and B-labels per municipality is 24.6 % in 2010, in the German speaking part it is 18.4 %

to a 8.6% increase in hybrid sales. Bento et al. (2009) suggest that the impact of a 25 cent gasoline price increase has only a marginal impact on fuel economy: 0.08% increase of mileage per gallon in the short-run (1 year) and a 0.16% increase in the long-run (10 years), mostly through the increased scrapping of old and inefficient vehicles.

Table 2: Panel Model, Energy Label

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | *Share of A- and B-label vehicles* | | | | |
| Share French | 0.041*** | 0.035*** | 0.031*** | 0.031*** | 0.035*** |
| | (0.004) | (0.004) | (0.004) | (0.004) | (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
***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.10$

Table 3: RDD Cross Section - 2nd Stage

| | | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|---|
| | | *Share of A- and B-label vehicles* | | | | |
| 2008 | Share French | 0.031*** | 0.039*** | 0.054*** | 0.047*** | 0.047*** |
| | | (0.005) | (0.006) | (0.011) | (0.010) | (0.010) |
| | Observations | 1,833 | 528 | 749 | 351 | 351 |
| | $R^2$ | 0.573 | 0.675 | 0.601 | 0.624 | 0.687 |
| 2009 | Share French | 0.038*** | 0.046*** | 0.065*** | 0.054*** | 0.051*** |
| | | (0.006) | (0.007) | (0.013) | (0.012) | (0.011) |
| | Observations | 1,833 | 528 | 749 | 351 | 351 |
| | $R^2$ | 0.552 | 0.617 | 0.554 | 0.585 | 0.680 |
| 2010 | Share French | 0.039*** | 0.045*** | 0.068*** | 0.054*** | 0.053*** |
| | | (0.007) | (0.008) | (0.014) | (0.013) | (0.011) |
| | Observations | 1,835 | 528 | 751 | 353 | 353 |
| | $R^2$ | 0.542 | 0.587 | 0.522 | 0.555 | 0.697 |
| 2011 | Share French | 0.043*** | 0.048*** | 0.083*** | 0.063*** | 0.060*** |
| | | (0.008) | (0.009) | (0.016) | (0.014) | (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*** | 0.036*** | 0.074*** | 0.054*** | 0.052*** |
| | | (0.008) | (0.009) | (0.016) | (0.015) | (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 |
| Polynimial | | 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
***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.10$

We believe that the specific element of culture which influences consumer preferences for energy efficient vehicles can be found in people's concern for the environment. Similarly to Eugster et al. (2011), we use popular voting outcomes to depict people's undelying values. Popular votes in Switzerland are held on a regular basis and allow the entire population to vote on propositions initiated by their fellow countrymen. A graphical representation of the voting outcomes shows the same discontinuity at the language border as previously shown for the energy labels. In Figure 5 we present the outcome of the six most recent popular votes on environmental issues in Switzerland. All graphs indicate that voters in the French speaking regions are more favorable to environmental issues than their German speaking counterparts[9].

[9]We use results of six popular votes, obtained from the Swiss Federal Office of Statistics (BFS):

- Initiative for non-genetically modified food ("für Lebensmittel aus gentechnikfreier Landwirtschaft"), Nov. 27$^{th}$ 2005; accepted with 55.7% (participation 42.24%). The initiative bans genetically modified food in Switzerland for the following five years.
- Bulding Society Initiative ("Bauspar Initiative"), March 11$^{th}$ 2012, rejected with 44.2% (participation 44.99%). Tax credit for Energy Efficient buildings and renovations.
- Initiative against food speculation ("Keine Spekulation mit Nahrungsmitteln!"), Feb. 28$^{th}$ 2016, rejected with 40.1% (participation 62.91%).
- Green Economy ("Grüne Wirtschaft"), Sept. 25$^{th}$ 2016, rejected with 36.4% (participation 43%). The initiative proposed an amendment to the constitution in order to reduce the Swiss resource and energy consumption until 2050-
- Initiative against nuclear energy ("Atomausstiegsinitiative"), Nov. 27$^{th}$ 2016, rejected with 45.8% (participation 45.38%). The initiative proposed to reduce the lifetime for existing nuclear energy plants and ban new ones.
- Energy Strategy 2050 ("Energiestrategie 2050"), May 21$^{st}$ 2017, accepted with 58.2%, (participation 42.89%).The initiative combines several measures to reduce energy consumption, increase energy efficiency and support renewable energy production.

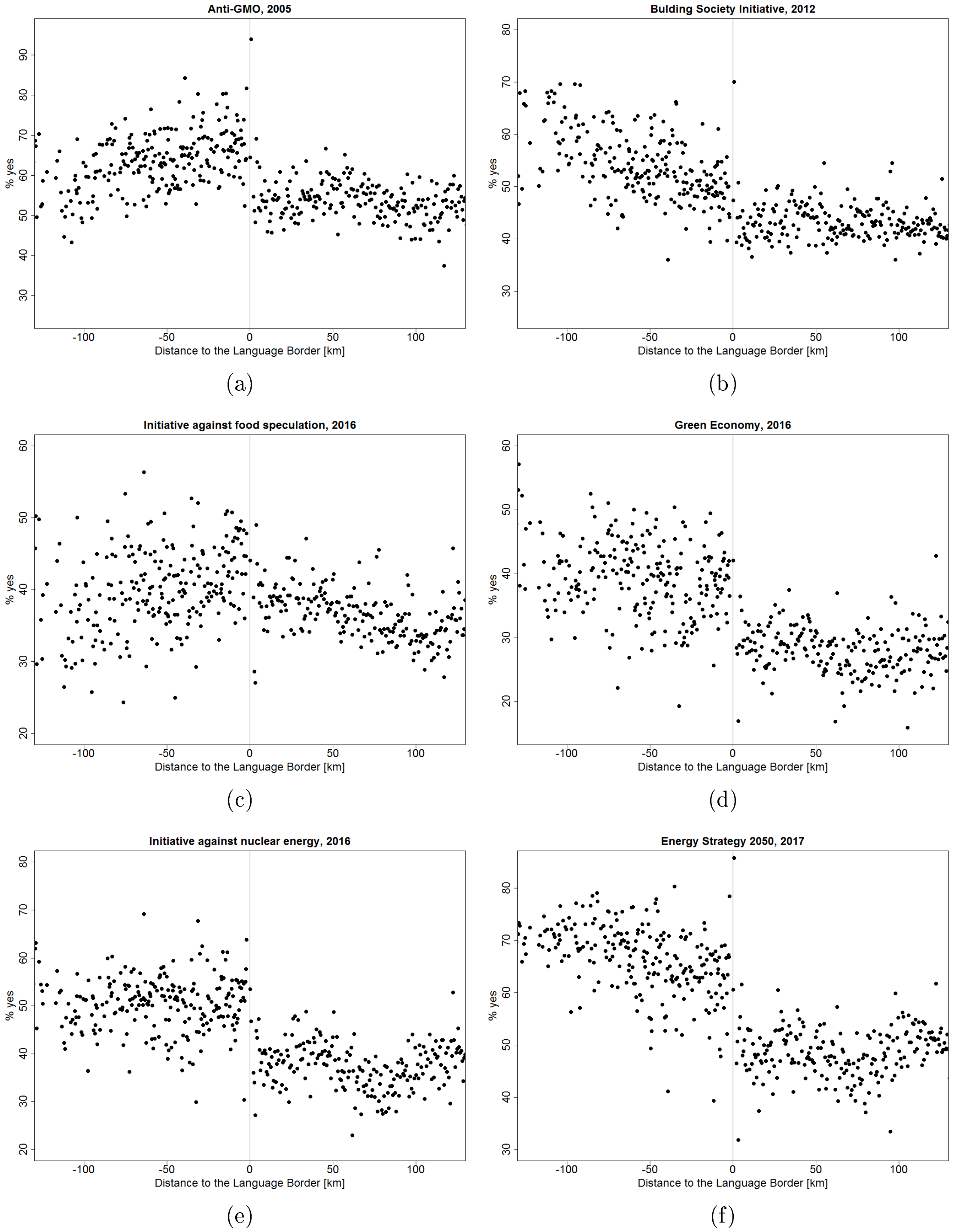



Figure 5: Voting outcomes for environmental popular initiatives
Source: BFS

# 6 Conclusions

In this paper, we analyze to which extent culture, expressed through native language, affects consumer preferences for fuel efficient vehicles. Our results support theoretical models from the literature which suggest that consumer choices are influenced directly by culture, independently of institutions (see (Atkin, 2016, Bisin and Verdier, 2001, Guiso et al., 2006)). In the context of a growing literature on the influence of culture in economics, our study adds a cultural dimension to the environmental economics literature by suggesting that there is a clear effect of culture on environmental decision making and more specifically on efficient vehicle choice. Moreover, our observations on voting outcomes allow us to argue that consumers' concern for the environment is the major channel through which culture affects energy efficient vehicle preferences. Concerns for the envrionment in turn have been identified by the literature as a factor for energy efficient vehicle choice ((Gallagher and Muehlegger, 2011, Kahn, 2007)). In Switzerland, unique conditions allow for a natural experiment to estimate the direct effect of culture on consumer preferences: several culturally distinct groups, expressed via different native languages, live in the same country and share most institutions. In order to estimate the treatment effect of culture, we used a dataset containing all registered vehicles in Switzerland for 2008 to 2012. We aggregated the data at a municipality level and added socio-economic variables, the share of French speakers and the distance from each municipality to the language border. In order to estimate the effect of culture on efficient vehicle choice, we perform a spatial fuzzy RDD at the internal Swiss language border.

Results indicate that culture accounts for a difference of about 5.5 percentage points, 88% of the total difference, in the amount energy efficient vehicles between the French speaking regions of Switzerland and their German speaking counterparts. Since the efficiency labels control for curb weight, the results imply that French-speaking consumers, given a type of vehicle, would prefer the more efficient vehicles. In addition, the difference in fuel efficiency between the language regions is not due to a preference for German/French car brands as we control for this variable (in addition, we control for all vehicle brands in the individual linear probability model). The magnitude of our results correspond to the effect of standard rebate policies for energy efficient vehicles documented in the literature. In addition, we find that popular votes on environmental issues receive a significantly higher share of approval in the French speaking regions, indicating that they place a higher value on the environment.

For policy makers this result has two implications: first, to introduce additional policy measures, such as marketing, which address culture as a factor. Second, to direct traditional economic policy efforts to groups where the potential outcome is higher. Switzerland is organized as a federal state where the cantons have a large autonomy and can decide on most environmental policies themselves. Since the French speaking population is more sensitive to environmental concern, policy makers could use other channels to target environmental goals, mainly by trying to directly influence consumer preferences via marketing and campaigning. In contrast, the German speaking part of Switzerland, which shows a lower concern for the environment, could be adressed with more traditional monetary incentives.

# 7 Appendix

## 7.1 Robustness Checks

In order to further analyze the robustnes of our results, we conduct the same fuzzy RDD using as a dependent variable $CO_2$ emissions and mean fuel consumption. Further, we also apply a non-parametric fuzzy RDD. Finally, we decided to exploit the individual data and estimate a probit model. In this case, we are interested to know the impact of culture on the probability that an energy efficient car is adopted. Of course, one downside of this approach is that the explanatory variables are not measured at the individual but at the municipality level. However, we believe that this model represents a valid robustness check.

In Tables 4 and 5 we present the results of a panel fuzzy RDD using as dependent variables the mean $CO_2$ emissions and mean fuel consumption of a municipality's car fleet. Results are similar to the results reported in Table 3 and suggest that $CO_2$ emissions and fuel consumption follow the same trend as the distribution of A- and B-labels, although the effect is less significant than with the labels. The underlying reason is that labels do not measure absulute emissions and consumption but are relative to the curb weight.

Table 6 shows the results of a non-parametric fuzzy RDD using a uniform Kernel density estimation with a first order polynomial local linear regression. In order to determine the optimal bandwidth of the RDD, we use the non-parametric procedure by Calonico et al. (2014) and Calonico et al. (2015), which yields an optimal bandwidth of 15.85km. Results confirm the sign of the treatment effect, found using the parametric RDD. However, we believe that in our case, the parametric approach is more appropriate because the error terms of our parametric estimations follow a normal distribution.

Table 7 shows a fuzzy RDD using individual data from 2010 (linear probability model). Results indicate that the probability of choosing an energy efficient car is higher in the French speaking regions and persists as we approach the language border. In column (5) of table 4 we introduce control variables, including vehicle brand, which does not have a large effect on the language estimate. This implies that the measured effect of language does not depend on consumer preferences for certain brands.

Table 4: RDD CO2 - 2nd Stage

| | | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|---|
| | | *Median CO2 Emmisions per Municipality* | | | | |
| 2008 | Share French | -7.257*** | -7.913*** | -5.413** | -5.358*** | -5.316*** |
| | | (1.260) | (1.466) | (2.133) | (2.035) | (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*** | -7.857*** | -5.771*** | -5.254*** | -5.011*** |
| | | (1.245) | (1.484) | (2.053) | (1.913) | (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*** | -6.896*** | -5.947*** | -4.708** | -4.814*** |
| | | (1.401) | (1.677) | (2.287) | (2.174) | (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*** | -6.852*** | -7.929*** | -5.055** | -5.011*** |
| | | (1.329) | (1.532) | (2.243) | (2.064) | (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*** | -6.690*** | -7.704*** | -5.316** | -5.316*** |
| | | (1.286) | (1.561) | (2.431) | (2.220) | (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 |
| Polynimial | | 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
***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.10$

Table 5: RDD Fuel Economy - 2nd Stage

| | | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|---|
| | | *Median Fuel Consumption per Municipality* | | | | |
| 2008 | Share French | -0.309*** | -0.336*** | -0.232** | -0.236*** | -0.232*** |
| | | (0.054) | (0.062) | (0.091) | (0.086) | (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*** | -0.355*** | -0.296*** | -0.268*** | -0.259*** |
| | | (0.054) | (0.065) | (0.091) | (0.085) | (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*** | -0.322*** | -0.299*** | -0.231** | -0.239*** |
| | | (0.060) | (0.070) | (0.099) | (0.094) | (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*** | -0.264*** | -0.303*** | -0.198** | -0.197*** |
| | | (0.056) | (0.065) | (0.095) | (0.089) | (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*** | -0.253*** | -0.305*** | -0.211** | -0.216*** |
| | | (0.053) | (0.065) | (0.103) | (0.093) | (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 |
| Polynimial | | 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
***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.10$

Table 6: Non-parametric fuzzy RDD

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

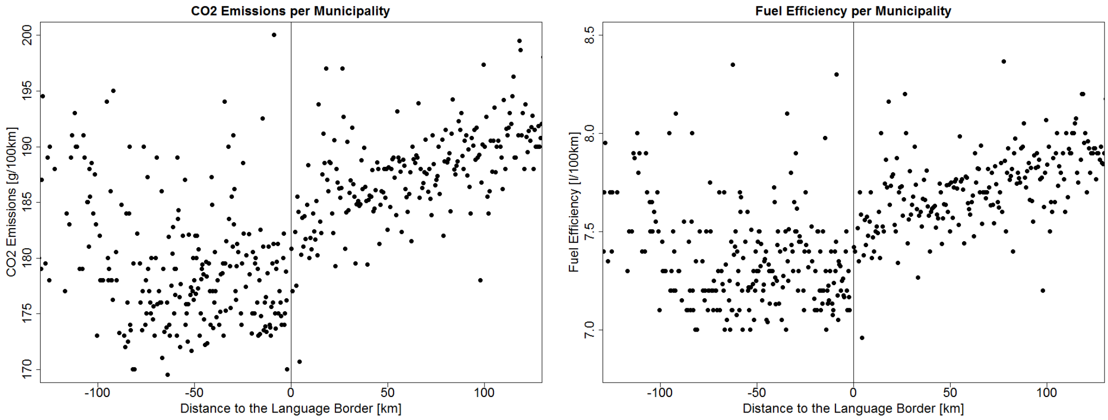
Data from 2010; *Bilingual Cantons: Bern, Valais and Fribourg
**Optimal bandwidht using the stata package rdrobust
Standard errors in parentheses, uniform kernel
***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.10$

Table 7: Lniear Probability RDD with Individual Data

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | | *A-or B-Label Vehicle* | | | |
| Share French | 0.039*** | 0.081*** | 0.092*** | 0.052*** | 0.047*** |
| | (0.009) | (0.019) | (0.015) | (0.010) | (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 |
| Polynimial | Cubic | Cubic | Quadratic | Linear | Linear |
| Covariates | No | No | No | No | Yes |

*Bilingual Cantons: Bern, Valais and Fribourg
Data from 2010; Canton FEin all models, covariates include car brand
Municipality clustered standard errors in parentheses
***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.10$

## 7.2 Graphs




(a) (b)

Figure 6: $CO_2$ Emissions and Fuel Efficiency (in 2010)
Source: BFS and ARE

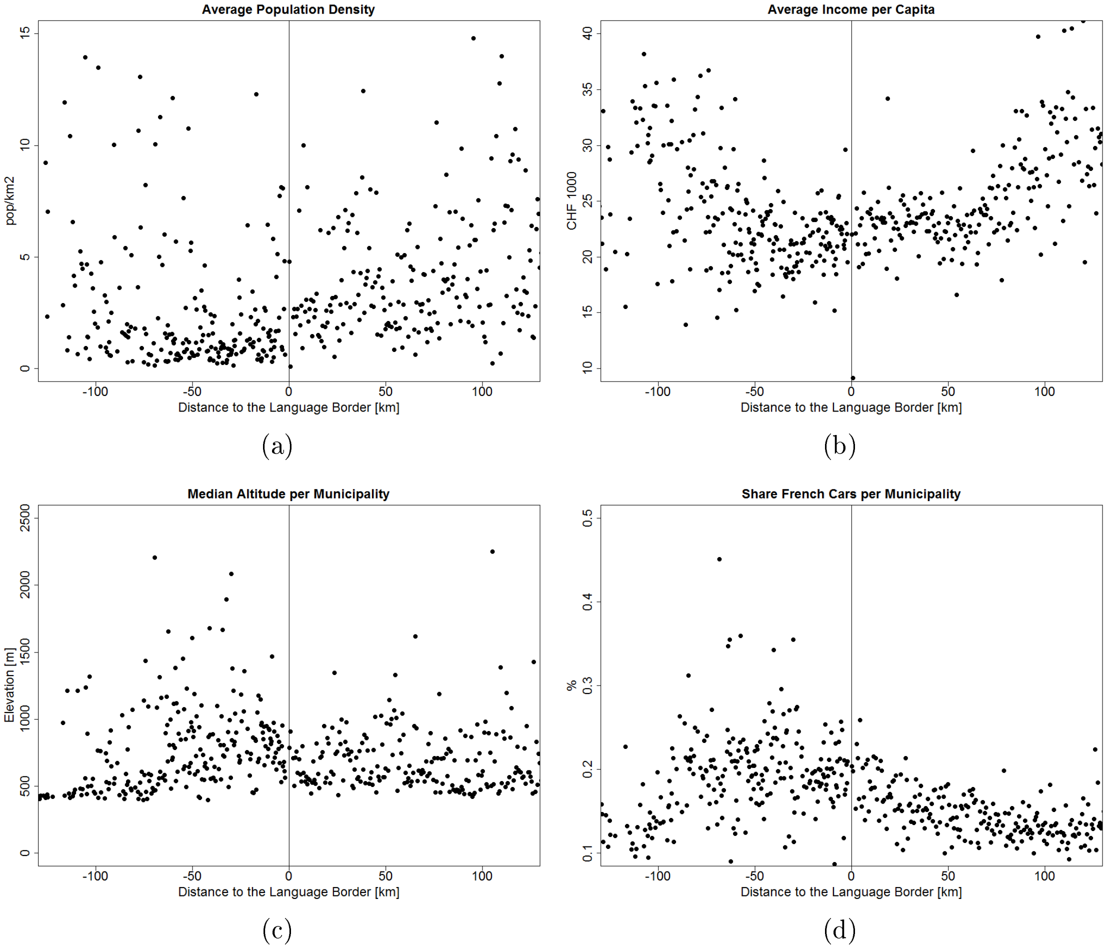



Figure 7: Mean Population Density, Income per Capita and Altitude (in 2010)
Source: BFS and ARE

# 8 References


Ahern, K. R., Daminelli, D., and Fracassi, C. (2015). Lost in translation? the effect of cultural values on mergers around the world. *Journal of Financial Economics*, 117(1):165–189.

Alberini, A., Bareit, M., Filippini, M., and Gutbrodt, S. (2015). Economic Analysis of Policy Measures to Reduce CO2 Emissions of Passenger Cars in Switzerland: Descriptive Statistics. Technical report, Zürich.

Alesina, A. and Giuliano, P. (2015). Culture and institutions. *Journal of Economic Literature*, 53(4):898–944.

Allcott, H. and Knittel, C. (2017). Are consumers poorly-informed about fuel economy? evidence from two experiments. Working Paper 23076, National Bureau of Economic Research.

Atkin, D. (2016). The caloric costs of culture: Evidence from indian migrants. *The American Economic Review*, 106(4):1144–1181.

Bento, A. M., Goulder, L. H., Jacobsen, M. R., and Von Haefen, R. H. (2009). Distributional and efficiency impacts of increased us gasoline taxes. *The American Economic Review*, 99(3):667–699.

Beresteanu, A. and Li, S. (2011). Gasoline prices, government support, and the demand for hybrid vehicles in the united states. *International Economic Review*, 52(1):161–182.

Bisin, A. and Verdier, T. (2001). The economics of cultural transmission and the dynamics of preferences. *Journal of Economic theory*, 97(2):298–319.

Brounen, D. and Kok, N. (2011). On the economics of energy labels in the housing market. *Journal of Environmental Economics and Management*, 62(2):166–179.

Calonico, S., Cattaneo, M. D., and Titiunik, R. (2014). Robust Nonparametric Confidence Intervals for Regression-Discontinuity Designs. *Econometrica*, 82(6):2295–2326.

Calonico, S., Cattaneo, M. D., and Titiunik, R. (2015). rdrobust: An r package for robust nonparametric inference in regression-discontinuity designs. *R Journal*, 7(1):38–51.

Chandra, A., Gulati, S., and Kandlikar, M. (2010). Green drivers or free riders? an analysis of tax rebates for hybrid vehicles. *Journal of Environmental Economics and management*, 60(2):78–93.

Chen, M. K. (2013). The effect of language on economic behavior: Evidence from savings rates, health behaviors, and retirement assets. *The American Economic Review*, 103(2):690–731.

Costa, D. L. and Kahn, M. E. (2013). Energy conservation "nudges" and environmentalist ideology: Evidence from a randomized residential electricity field experiment. *Journal of the European Economic Association*, 11(3):680–702.

Desmet, K., Ortuño-Ortín, I., and Wacziarg, R. (2012). The political economy of linguistic cleavages. *Journal of development Economics*, 97(2):322–338.

Egger, P. H. and Lassmann, A. (2015). The causal impact of common native language on international trade: Evidence from a spatial regression discontinuity design. *The Economic Journal*, 125(584):699–745.

Eugster, B., Lalive, R., Steinhauer, A., and Zweimüller, J. (2011). The demand for social insurance: does culture matter? *The Economic Journal*, 121(556):F413–F448.

Falk, A., Becker, A., Dohmen, T. J., Enke, B., and Huffman, D. (2017). The nature and predictive power of preferences: Global evidence. (9504).

Fearon, J. D. (2003). Ethnic and cultural diversity by country. *Journal of economic growth*, 8(2):195–222.

Fehr, E. and Hoff, K. (2011). Introduction: Tastes, castes and culture: The influence of society on preferences. *The Economic Journal*, 121(556).

Filippini, M., Alberini, A., Bareit, M., and Gutbrodt, S. (2015). Module 1: Descriptive statistics. *Economic analysis of policy measures to reduce CO2 emissions of passenger cars in Switzerland*, page 55.

Gallagher, K. S. and Muehlegger, E. (2011). Giving green to get green? incentives and consumer adoption of hybrid vehicle technology. *Journal of Environmental Economics and management*, 61(1):1–15.

Gentili, E., Masiero, G., and Mazzonna, F. (2017). The role of culture in long-term care arrangement decisions. *Journal of Economic Behavior & Organization*, 143(Supplement C):186 – 200.

Giannetti, M. and Yafeh, Y. (2012). Do cultural differences between contracting parties matter? evidence from syndicated bank loans. *Management Science*, 58(2):365–383.

Goldberg, P. K. and Verboven, F. (2001). The evolution of price dispersion in the european car market. *The Review of Economic Studies*, 68(4):811–848.

Guiso, L., Sapienza, P., and Zingales, L. (2006). Does culture affect economic outcomes? *Journal of Economic Perspectives*, 20(2):23–48.

Guiso, L., Sapienza, P., and Zingales, L. (2009). Cultural biases in economic exchange? *The Quarterly Journal of Economics*, 124(3):1095–1131.

Heutel, G. and Muehlegger, E. (2015). Consumer learning and hybrid vehicle adoption. *Environmental and Resource Economics*, 62(1):125–161.

Hoff, K. and Stiglitz, J. E. (2016). Striving for balance in economics: Towards a theory of the social determination of behavior. *Journal of Economic Behavior & Organization*, 126:25–57.

Huse, C. and Lucinda, C. (2014). The market impact and the cost of environmental policy: evidence from the swedish green car rebate. *The Economic Journal*, 124(578):F393–F419.

Johansson, O. and Schipper, L. (1997). Measuring the long-run fuel demand of cars: separate estimations of vehicle stock, mean fuel intensity, and mean annual driving distance. *Journal of Transport Economics and policy*, pages 277–292.

Kahn, M. E. (2007). Do greens drive hummers or hybrids? environmental ideology as a determinant of consumer choice. *Journal of Environmental Economics and Management*, 54(2):129–145.

Klier, T., Linn, J., et al. (2010). The price of gasoline and new vehicle fuel economy: Evidence from monthly sales data. *American Economic Journal: Economic Policy*, 2(3):134–153.

Knight, G. A. (1999). Consumer preferences for foreign and domestic products. *Journal of Consumer Marketing*, 16(2):151–162.

Lee, D. S. and Lemieux, T. (2010). Regression discontinuity designs in economics. *Journal of economic literature*, 48(2):281–355.

Mundlak, Y. (1978). On the pooling of time series and cross section data. *Econometrica: journal of the Econometric Society*, pages 69–85.

Novembre, J., Johnson, T., Bryc, K., Kutalik, Z., Boyko, A. R., Auton, A., Indap, A., King, K. S., Bergmann, S., Nelson, M. R., et al. (2008). Genes mirror geography within europe. *Nature*, 456(7218):98–101.

Parsons, T., Shils, E. A., and Smelser, N. J. (1965). *Toward a general theory of action: Theoretical foundations for the social sciences*. Transaction publishers.

Schindler, R. M. and Holbrook, M. B. (2003). Nostalgia for early experience as a determinant of consumer preferences. *Psychology & Marketing*, 20(4):275–302.

Sexton, S. E. and Sexton, A. L. (2014). Conspicuous conservation: The prius halo and willingness to pay for environmental bona fides. *Journal of Environmental Economics and Management*, 67(3):303–317.

Small, K. A. and Van Dender, K. (2007). Fuel efficiency and motor vehicle travel: the declining rebound effect. *The Energy Journal*, pages 25–51.

Turrentine, T. S. and Kurani, K. S. (2007). Car buyers and fuel economy? *Energy policy*, 35(2):1213–1223.

Whorf, B. L. (1997). The relation of habitual thought and behavior to language. In *Sociolinguistics*, pages 443–463. Springer.

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