Tax me if I win: overcoming reluctance to French carbon tax

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Abstract

Using a new survey and National households' survey data, we investigate French perception over carbon taxation. We find that French people largely reject a tax and dividend policy where revenues of the tax would be redistributed uniformly. However, their perception about the properties of the tax are largely biased: people overestimate the negative impact on their purchasing power, wrongly think the scheme is regressive, and do not perceive it as environmentally effective. Our econometric analysis shows that correcting these three bias would suffice to generate majority acceptance. Yet, we find that people's beliefs are well anchored and their revisions biased towards pessimism, so that only few can be convinced.

JEL classification: D72; D91; H23; H31; Q58

Keywords: Climate Policy; Carbon tax; Bias; Beliefs; Preferences; France; Perceptions

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1 Introduction

The French government had initially committed to an ambitious trajectory for the price of carbon. Initiated in 2014 at 7€/tCO_2, the French carbon tax reached 44.6€/tCO_2 in 2018 and was supposed to continue growing to hit 86.2€/tCO_2 by 2022. Yet, at the end of 2018, the same government that had accelerated the price trajectory decided to abandon it and froze the tax at its current level for an undetermined period. This dramatic shift in French climate policy is the direct consequence of the popular protest of the "Yellow vests" which started against the carbon tax. The increasing weight of carbon taxation was concomitant to other unpopular tax reforms and high barrel prices that contributed to increase public's discontent against it. The challenge for economists and policy makers is now to disentangle the determinants of the disapproval, and understand to what extend the rejection reflects intrinsic preferences or biased perceptions over the properties of carbon pricing.

In order to explain French attitudes towards carbon taxation, we conducted a survey on a representative sample of 3,002 French households. Our analysis focuses on three well-known determinants of acceptance of the carbon tax: the impact on one's purchasing power, the progressivity of the scheme, and its environmental effectiveness. We compare subjective beliefs elicited from our new survey to objective impacts on respondents' purchasing power that we estimate using their energetic characteristics and National households' survey data. This comparison shows that people largely over-estimate the negative impact of carbon taxation on their purchasing power. Similarly, while the scheme proposed in our survey —a carbon tax with uniform lump-sum transfer— is progressive, a large majority of individuals perceive it as regressive. Finally, a majority of respondents do not believe that such policy would reduce pollution and fight climate change. These results suggest that rejection of carbon taxation does not commonly result from clashing preferences, such as a disinterest for the ecology or a dislike for price instruments, but rather from biased beliefs about the properties of the reform. To show this point, we then investigate the effects on acceptance of "rectifying" the beliefs over each of these properties. We identify the effect of correcting one's belief by instrumenting each belief with a random treatment (usually an information randomly displayed or not). A first result is that displaying information convince only few people. For example, among those advantaged by the reform who wrongly believe they would lose, only 12% were convinced that they would gain when we disclosed them our estimation. Worse, respondents revise their beliefs in a biased way, giving more weight to new information when it is against the tax. That being said, conditional on being convinced, all three motives —self-interest, progressivity and environmental effectiveness— increase acceptance by 40 to 50 percentage points (p.p.) and correcting for biased beliefs would be sufficient to gather a majority acceptance.

A growing literature studies attitudes towards climate policies, as this issue is becoming critical in the public debate. For a thorough review of this literature, we refer to Carattini et al. (2018), and also signal the less recent Dresner et al. (2006a) and the more synthetic Klenert et al. (2018). Closely related to our paper, Stern et al. (1993) is an early work proposing and testing a model of preferences for environmental quality aimed at disentangling egoistic from altruistic motives on the one hand, and beliefs from values on the other hand. Among all possible attitudes, they show that belief about consequences on self-interest is the only predictor of the willingness to pay Pigouvian taxes. Using a post-electoral survey in Switzerland, Thalmann (2004) also finds a correlation between carbon tax acceptance and self-interest, proxied by the number of cars owned. In surveys on British and Swedish respondents respectively, Bristow et al. (2010) and Brannlund & Persson (2012) document a higher approval when the reform addresses distributional issues. Baranzini & Carattini (2017) report that a majority of the people they interviewed in Geneva do not believe the tax would be effective, which confirms what Dresner et al. (2006b) find with focus groups in the UK. Surveying Norwegian people, **?** shows that self-interest matters for acceptance, but less than concerns for environmental effectiveness or distributional effects.

In the present paper, we also study how these three motives affect acceptance. We contribute to the literature by providing evidence for causal effects where **?** and other past studies essentially show correlations. Besides, **?** study the three motives through proxies, such as fuel consumption to proxy self-interest. On the contrary, we do not assume that people are rational nor have perfect information. Thus, our methodology allows to disentangle erroneous beliefs from *pure* effects of preferences.

Several papers have shown that without earmarking of their revenue, carbon taxation is not perceived as environmentally effective (e.g. Dresner et al. (2006a), Sælen & Kallbekken (2011), Baranzini & Carattini (2017)). Our survey confirms this result, and also shows that *tax and dividend* is improperly seen as regressive. In addition, the paper contributes to the literature by quantifying biases regarding the costs of carbon tax. To our knowledge, we are the first to compare subjective beliefs about the private cost of the policy and objective data using micro-simulation, showing that 88% of people overestimate their private costs.

Another contribution of this paper is to show the anchoring of people's beliefs over carbon tax policies. Such anchoring can be related to a well established literature which shows that people tend to be conservative when revising their beliefs after new information (e.g. Edwards, 1968), as well as to more recent works which rationalize the asymmetry of beliefs' revisions with intrinsic utility derived from good news (Bénabou & Tirole, 2002; Eil & Rao, 2011; Coutts, 2018).

The rest of the paper is organized as follows. In section 2, we describe our survey and other data sources. In section 3, we compare subjective perceptions to objective data, and measure the bias regarding the impact of carbon taxation on one's purchasing power. In section 4, we highlight new biases in the way individuals revise these beliefs. In section 5, we estimate the effects on acceptance of rectifying biased beliefs. Section 6 concludes. Further results and methodological complements are reported in Appendix.

2 Data

2.1 Survey "beliefs climate policies"

2.1.1 Survey data collection

The 3002 responses were collected in February and March 2019 through the survey company Bilendi. This company maintains a panel of French respondents whom they can email with survey links. Respondents are paid 2.50€ if they fully complete the survey. The respondents who choose to respond are first channeled through some screening questions that ensure that the final sample is representative along six socio-demographic characteristics: gender, age (5 brackets), education (4), socio-professional category (8), size of town (5) and region (9). The quotas are relaxed by 5% to 10% relative to actual proportions. Table 1 shows that our sample is still very representative. Nonetheless, observations are weighted to correct small differences between sample and population proportions. The median time for completion of the survey was 19 minutes. We made sure that all questions requiring some concentration were in the first half of the survey.

Table I: Sample Characteristics

gender	woman	man
Population	*0.52*	*0.48*
Sample	0.53	0.47

age	18-24	25-34	35-49	50-64	>65
Population	*0.12*	*0.15*	*0.24*	*0.24*	*0.25*
Sample	0.11	0.11	0.24	0.26	0.27

profession	farmer	independent	executive	intermediate	employee	worker	retired	inactive
Population	*0.01*	*0.03*	*0.09*	*0.14*	*0.15*	*0.12*	*0.33*	*0.12*
Sample	0.01	0.04	0.09	0.14	0.16	0.13	0.33	0.11

education	No diploma or *Brevet*	*CAP* or *BEP*	*Bac*	Higher
Population	*0.30*	*0.25*	*0.17*	*0.29*
Sample	0.24	0.26	0.18	0.31

size of town	rural	-20.00	20-99	>100	Paris area
Population	*0.22*	*0.17*	*0.14*	*0.31*	*0.16*
Sample	0.24	0.18	0.13	0.29	0.15

region	*IDF*	*Nord*	*Est*	*SO*	*Centre*	*Ouest*	*Occ*	*ARA*	*PACA*
Population	*0.19*	*0.09*	*0.13*	*0.09*	*0.10*	*0.10*	*0.09*	*0.12*	*0.08*
Sample	0.17	0.10	0.12	0.09	0.12	0.10	0.08	0.13	0.08

2.1.2 The survey

The full survey in French can be seen on-line.[1] It contains several random branches and treatments that are independent from one another.

Priming on environmental issues Two blocks of information are randomly displayed or not: one on climate change and the other on particulate matter. This priming divides the sample in four groups, who received either one block of information, the other, none or both of them. Climate change information includes temperature trends for long run future, worrying facts on current and expected impacts, and a claim that keeping global warming below 2 ℃ is technically feasible. Particulate information consists in the estimated impact on French mortality (48,000 deaths per year), life expectancy (9 months less), and the assertion that reducing fuel consumption would improve health. The time spent on each block is saved, and links to scientific references are provided to support the information.

Household characteristics In addition to the quotas strata, socio-demographic characteristics include zip code, household structure, income of the respondent and of their household. Energetic characteristics contain questions that allow us to estimate the impact of a carbon tax increase on housing expenditures: surface of accommodation, heating type (collective or individual) and energy source; as well as on transport expenditures: number of vehicles, type(s) of fuel, distance traveled last year and average fuel economy. The distributions of answers are much in-line with official statistics. TODO

Partial tax reforms To study the perception of different indirect taxes, respondents are first asked using a Likert scale whether they would lose more or less purchasing power than the average French household through an increase of the VAT tax (where both additional rate and usage of the revenues remain unspecified). Then, one partial tax reform is randomly allocated to the respondent: it consists in an increase of the carbon tax by 50€/tCO_2 specific either to heating fuel and gas, or to gasoline and diesel. Partial reforms on housing and transport feature the same string of questions. Similarly to the VAT question, it starts with the relative loss of purchasing power. Then, we specify in a new block that the revenues of the tax would be distributed equally to each adult, entailing a yearly transfer of 50€ (resp. 60€) for the partial tax on housing (resp. transport). We also provide the price increases implied by the tax: +13% (resp. +15%) for gas (resp. domestic fuel) on the one hand, and +0.11€

[1] hbs.qualtrics.com/jfe/form/SV_9zqdJWZXgpWfjsF

(resp. +0.13€) for a liter of gasoline (resp. diesel) on the other. Then, we ask the respondent whether their household would win, lose or be unaffected by the reform. Depending on their answer, we further ask them to estimate their expected gain (or loss) among 5 (or 6) intervals. The interval thresholds are tailored to each respondent, as they are computed in proportion of the number of consumption units of their household (as defined by Eurostat). Finally, respondents are asked to estimate their own elasticity as well as that of French people. To this end, we borrow the phrasing of Baranzini & Carattini (2017), and ask the expected decrease in consumption that would follow a 30% increase in the price of heating (or equivalently, an increase of 0.50€ in fuel prices), among 5 brackets.

Compensated carbon tax increase

Perceptions *ex ante* Our main reform of interest is an increase by 50€/tCO_2 of the French carbon tax, that concerns both housing and transport. The revenues generated are redistributed equally, so that each adult receives a yearly lump-sum compensation of 110€. This amount was computed using the elasticities estimates by Douenne (2018): -0.4 for transport and -0.2 for housing, as well as an incidence borne at 80% by consumers. After describing the reform, a first block of questions elicits the respondent's perceptions. Their subjective gain is asked in the same manner as for the partial tax. The priming that "scientists agree that a carbon tax would be effective in reducing pollution" is randomly displayed or not before asking whether the reform would be effective in reducing pollution and fighting climate change. Then, respondents are asked to pick the categories of losers and winners with the reform. Finally, we ask: "Would you approve this reform?" and let the respondent choose between "Yes", "No" and "PNR (I don't know, I don't want to answer)". In the following, we say that a respondent *approve* a reform if they respond "Yes", and that they *accept* the reform if they do *not* respond "No". Given the low rates of approval, we study primarily the acceptance to get tighter confidence intervals.

Opinion *after knowledge* To test the persistence of beliefs and measure the importance of self-interest and fairness motives in the acceptance of the reform, we provide some information on the effect of the reform. To a random half of the sample, we explain that "this reform would increase the purchasing power of the poorest households and decrease that of the richest, who consume more energy". To two-thirds of the respondents (the remaining half plus one third of the respondent with that priming on *progressivity*), we tell that: "In five cases over six, a household with your characteristics would [win/lose] through the reform. (The characteristics taken into account are: heating using [energy source] for an accommodation of [surface] m^2; [distance] km traveled with an average consumption of [fuel economy] L for 100 km.)". Indeed, section 2.2.2 shows that we estimate correctly if a household wins or lose in 83% of cases.

During the survey collection, we understood that most respondents did not believe the claim that the reform was progressive, so we asked to the second half of the sample whether they thought it was, to analyze the effects of priming on these compliant respondents. We also ask again the winning category (i.e. if the respondent's household would win, lose or be unaffected by the reform) and the approval to the reform. Finally, we let the respondent pick the reasons why this reform seems beneficial, and undesirable. TODO: stats des

Tax increase with targeted compensation In this block, we ask for the winning category and for the approval of four alternative reforms. Each respondent deals with just one of them, which differs from the main reform only in the way revenues are recycled. Here, the payments, still equal among recipients, are targeted to adults whose income is below some threshold. The four threshold correspond to the bottom 20%, 30%, 40% and 50% of the income distribution. They are computed using inflated deciles of individual income from the *Enquête sur les Revenus Socio-Fiscaux* (ERFS 2014) produced by Insee (the French national statistics bureau).[2] Respondents whose income lies between two thresholds are allocated randomly to a reform featuring one of them. When the income is close to only one threshold (i.e. when its percentile in the distribution is below 20 or within $[50; 70]$), the allocated reform corresponds to that one. When the respondent's income is above 2220€/month (which is the 70th. percentile), the reform they face is determined by the income of their spouse. Finally, when both (or the only one) adults in the household earn more than 2220€/month, their reform is allocated randomly between the four variants. Table II describes the targeted reforms and the proportion of respondents allocated to each of them, along with the proportion one would expect from the *ERFS*. The two sets of figures matches almost perfectly, indicating that our sample is representative along the income dimension.

Other questions We do not detail the other questions of the survey, because we analyze them in a companion paper. TODO:ref We scrutinize opinions on environmental policies, including other ways to

[2]Incomes entitled to the household rather to its members, such as certain welfare benefits, are divided equally among the two oldest adults of the household.

Table II: Characteristic of the targeted reform by target of the payment.

Targeted percentiles	≤ 20	≤ 30	≤ 40	≤ 50
Income threshold (€/month)	780	1140	1430	1670
Payment to recipients (€/year)	550	360	270	220
Proportion of respondents	.356	.152	.163	.329
Expected proportion of respondents	*.349*	*.156*	*.156*	*.339*

recycle the revenues of a carbon tax. We measure the knowledge and perceptions of climate change; ask some specific questions over shale gas, over the influence of climate change on the choice to give birth and on willingness to change one's lifestyle. We study the use, availability and satisfaction with public transportation and active mobility. We ask political preferences, including the positioning in relation to *yellow vests*. Finally, we let the respondent express any comment in a text box.

2.1.3 Ensuring data quality

We took several steps to ensure the best possible data quality. We excluded the 4% of respondents who spend less than 7 minutes on the full survey. We confirm that response time is not significantly correlated with our variable of interest (such as approval or subjective gain). In order to screen out inattentive respondents, a test of quality of the responses was inserted, which asked to select "A little" on a Likert scale. The 9% of respondents who failed the test were also excluded from our final sample of 3002 respondents. Also, when the questions about a reform were spread over different pages, we recalled the details of the reform on each new page. We checked for careless or strange answers on numerical questions, such as income or the size of the household. We flagged 10 respondents with aberrant answers to the size of the household (above 12) and up to 250 respondents with inconsistent answers, such as a size of household smaller than the number of adults, or a household income smaller than individual income. An examination of these answers shows no significant correlation with our variables of interest, and suggests that these respondents have simply mistaken the question (e.g. they may have confounded the zip code with the household size, or household income with individual income). Also, 58 respondents have answered more than 10,000€ as their monthly income (despite the word "monthly" being in bold and underlined), with answers in the typical range of French incomes. We have divided these figures by 12.

2.2 French households surveys

2.2.1 Comparing objective and subjective tax incidence

One of the objectives of the paper is to compare respondents' perceptions with actual impact of a carbon tax on households' purchasing power. For this purpose, we use the database constructed by Douenne (2018) whose objective was to estimate the distributive effects of a carbon tax for French households. This database matches two households surveys produced by Insee: the consumer survey *Budget de Famille* (BdF 2011) and the transport survey *Enquête Nationale Transports et Déplacements* (ENTD 2008).

Consumer survey "Budget de Famille" The consumer survey *Budget de Famille* (BdF 2011) is a household survey providing information over all households' revenues and expenditures, together with many socio-demographic characteristics. It was conducted in several waves from October 2010 to September 2011 over a representative sample of 10,342 French households. The main advantage of BdF when studying the incidence of carbon taxation is that expenditures in both housing and transport energies are reported. Consumption of housing energies is taken from households' bills, and for most other goods respondents answer questionnaires to report their expenditures over a week. As explained in Douenne (2018), this data collection is problematic when looking at the incidence of a tax on transport energies, as short-run fluctuations in consumption lead to over-estimate the variation in expenditures.

Transport survey "Enquête Nationale Transports et Déplacements" To overcome this limitation, BdF is matched with the transport survey *Enquête Nationale Transports et Déplacements* (ENTD 2008). ENTD was conducted in several waves from April 2007 to April 2008 over a representative sample of 20,178 French households. It provides information on households characteristics, their vehicle fleet and their use over a week, but most importantly it gives information on annual distances travelled with these vehicles. This last information enables to recover the distribution of transport fuel expenditures without over-estimating its spread. Such a matching is not necessary for housing energies as these already represent consumption over long periods in BdF. Their distribution is very close to the one obtained from the housing survey *Enquête Logement* (EL 2013). Finally, data from National Accounts are used to make the data representative of the year 2017[3].

[3] National Accounts data for 2018 were not yet available.

Computation of tax incidence from survey data From this dataset we are able to compute the distribution of households' *objective* net gains in purchasing power after the policies proposed in our survey *Beliefs climate policies*. Computation is done using TAXIPP, a micro-simulation model of taxation for French households. This model was used in Douenne (2018) to compute the distributive effects of an increase in the French carbon tax. Our baseline simulations assume that 80% of the tax pass through consumers, and that households react to increases in prices with uncompensated price elasticities of -0.4 and -0.2 for transport and housing energies respectively.

2.2.2 Computing households expected net gains for the feedback

Simulating expected gains for the feedback Households are asked about yearly distance traveled and average fuel consumption of their private vehicles. From this information it is then possible to compute the expected cost of a carbon tax on transport fuels. For housing energies, the collected information does not enable such simple calculations. Instead, we use the housing survey *Enquête Logement* (EL 2013) that provides information on households expenditures in housing energies as well as many demographic and energetic characteristics.[4] This enables to compute the expected cost from the carbon tax on housing energies, and regress it on households' characteristics. The results are provided in appendix, where they are also compared to the ones obtained for alternative prediction methods. Adding this estimated cost to the one simulated for transport energies, and subtracting the amount received in lump-sum transfers, we estimate the impact of the policy on the purchasing power of any household.

Assessment of feedback's accuracy The previous estimation could have also been conducted with BdF data. Still, running this estimation on the housing survey enables to then test the accuracy of our prediction on BdF, without concerns about potential over-fitting. For each household in BdF, we compute the impact of the policy on their purchasing power and compare it to the prediction from our simulations. For five households out of six we correctly predict whether their purchasing power would have been increased or decreased by the policy. This ratio is symmetrical: among households in BdF predicted to win, 83.4% were actual winners, while among those predicted to lose, 83.4% were actual losers. Since the simulation and its test are done on different households, we can consider that the

[4]The survey was conducted between June 2013 and June 2014 over a sample of 27,137 households in metropolitan France. The distribution of housing energy expenditures is very comparable to the one of BdF.

probability that our feedback is correct is not over-estimated. Assuming the information reported by our respondents is correct, there is no reason to believe that the probability of error is higher or lower when simulations are applied to our survey respondents.

3 Perceptions

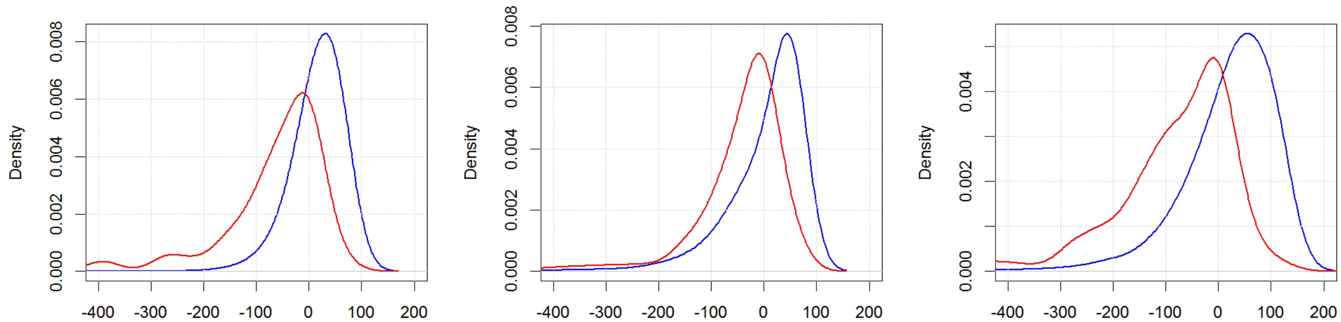
3.1 Impact on purchasing power

Over-estimation of policy costs Figure 1 plots the kernel density of expected net gains for objective data from matched BdF, and subjective beliefs from our survey. The subjective intervals have been translated into numerical values, assuming that the distribution within each interval was the same than for matched BdF data. Figure 2 compares the CDF of objective versus subjective net gains. It shows that the latter assumption is conservative and does not lead to over-estimate the gap between objective and subjective gains. It clearly appears from these figures that on average respondents over-estimate the cost of the policy. This result holds both for the carbon tax and for partial carbon taxes on transports and housing energies. The average net gains from the carbon tax on transport, housing and both, are respectively 18€ per consumption unit (c.u.), 6€ per c.u. and 24€ per c.u. from BdF data. Extrapolating from our survey, we instead find average expected (subjective) net gains of respectively −61€, −43€ and −89€. While 70.3% of households should benefit (in monetary terms) from the compensated carbon tax, only 14% think they would (22% see themselves unaffected). For transport and housing energy taxes, the objective proportion of winners is respectively 73.6% and 67.5%, while the subjective shares are 16% and 17% (with 22% and 30% of unaffected).

An heterogeneous bias TODO: examine whether some categories are on average more wrong than others.

3.2 Robustness to assumptions on elasticities

Households perceived elasticities On average, respondents perceived transport fuel price elasticity of French people at −0.43, and their own elasticity at a consistent −0.41 (after reweighting by fuel expenditures). 71% of respondents see themselves as more constrained than average for fuel consumption,



(a) on transport fuels (b) on housing energies (c) on both

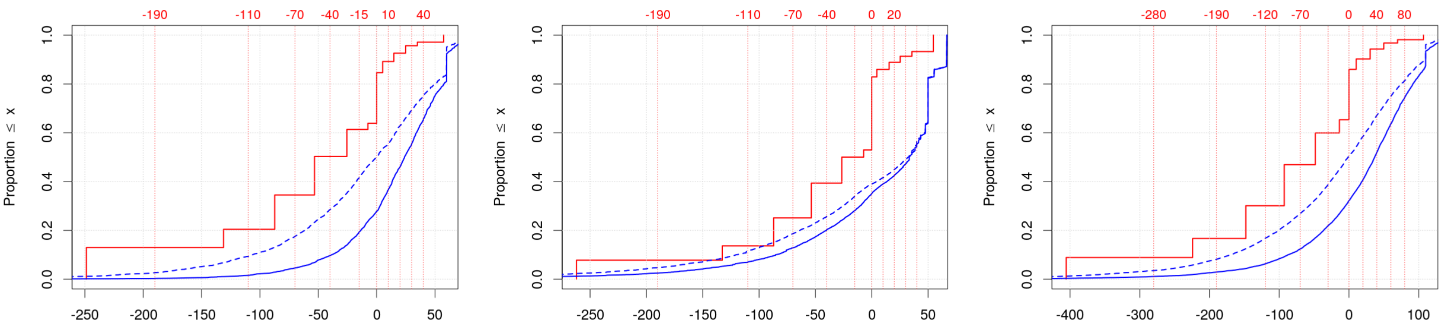
Figure 1: Distribution of objective (blue) vs. subjective (red) net gains from a carbon tax and dividend policy (in € per year per c.u.).

which is slightly higher than the objective share of households who spend more fuel than average: 59%. Concerning housing energies, aggregate and personal subjective elasticities are respectively -0.41 and -0.33. For transport fuels, the average perceived aggregate elasticity is consistent with the literature (TODO:ref), which is consistent with the findings of (TODO:ref). For housing energies, respondents correctly estimate their own elasticity, but they overestimate the aggregate one. Among several possible explanations, we might think people discount too much the non-monetary costs of investing in new equipment in the future, especially when it comes to others. Another possible explanation is that housing energy prices being little salient, their actual reaction to price changes is smaller than they wish.

Robustness of the results The gap between objective and subjective net gains from carbon tax cannot be explained by households' lower perceived elasticities. As a lower bound on the expected share of losers, we can simulate the distribution of net gains for perfectly inelastic households. Even in this extreme case, we should expect 52.6% of winners from compensated carbon tax (52.2% and 63.6% for transport and housing energy taxes respectively).

3.3 Perception on other tax' properties

Environmental effectiveness A well established result in the literature on the acceptability of climate policies is the perceived ineffectiveness of Pigouvian instruments [Kallbekken et al. (2011); TODO: complete]. In particular, people do not see carbon taxes as effective to fight climate change. Our find-



(a) on transport fuels

(b) on housing energies

(c) on both

Figure 2: CDF of objective (blue) vs. subjective (red) net gains from a carbon tax and dividend policy (in € per year per c.u.). Dashed blue lines represent distributions of objective gains in the extreme case of totally inelastic expenditures. Vertical dotted red lines show the limits of intervals answers of subjective gains.

ings confirm this result: among our survey respondents, only 16.6% answered yes when asked whether the carbon tax and dividend policy would be effective reducing pollution and fighting climate change. 65.9% answered no, 17.6% that they did not know. A tempting interpretation often made is that this belief results from the assumed inelastic behavior of consumers (Kallbekken & Sælen (2011); TODO: complete). To test this hypothesis, we regress a binary variable equal to 0 if the respondent does not perceive the policy as environmentally effective, and 1 otherwise, on its subjective price elasticity for French people. As respondents were randomly asked about responses to prices for transport or domestic energies, we do the exercise for both types of energies. Table X in appendix reports results with and without control variables. They all consistently indicate that individuals with stronger (i.e. more negative) aggregate price elasticities are more likely to perceive the policy as environmentally effective. The results are statistically significant and similar for transport and housing price elasticities, both associated with a coefficient around -0.07. In other terms, holding other variables constant, a respondent anticipating a price elasticity of -0.5 is 3.5 percentage points (p.p.) more likely to perceive the policy as effective than one anticipating no elasticity. Although significant, the magnitude of the effect remains therefore rather limited and the perceived ineffectiveness of tax instruments should not be reduced to anticipated elasticities. A large share of respondents do anticipate responses to price signals and still perceive the policy as environmentally ineffective.[5]

It is still possible to reconcile the perceived ineffectiveness of the policy with beliefs about elasticities. Taking respondents average anticipated elasticities for transport and housing energies, we can simulate from BdF data the expected reduction in greenhouse gas (GhG) emissions due to the policy. Our simulations indicate a reduction in emissions by 5.7Mt of CO_2 equivalent (CO_2e) per year, that is around 1.2% of total French annual emissions, and 0.01% of global emissions.[6] Thus, although respondents do anticipate responses to price incentives, they might still expect these changes to be too small to make a significant difference with respect to pollution or climate change. An interpretation of our results is therefore that beliefs are consistent with a perceived effectiveness, but inefficacy of a 50€/tCO_2 carbon tax and dividend policy.

Progressivity It is often argued that a critical barrier to acceptance of carbon taxation is its perceived distributional impact, in particular the higher burden imposed on lower income households (TODO: ref.). A large literature has shown that carbon taxation alone is regressive (Poterba, 1991; Metcalf, 1999; Grainger and Kolstad, 2010), meaning that it is more costly for poorer households as a share of their resources. However, it has also been shown that redistributing its revenue through uniform lump-sum transfers — a mechanism known as flat-recycling — can make the policy progressive (West and Williams, 2004; Bento et al, 2009; Williams et al, 2015), including for France (Bureau, 2011; Douenne, 2018). Figure 4 in appendix displays the average net gain by income decile of the carbon tax and dividend policy. It clearly appears from this figure that lower income households should gain more than richer households. This holds both in relative and absolute terms. Yet, only 19.4% of our survey respondents think the policy would benefit poorer households, against 59.5% who declared it would not, and 21.1% who do not know. These results show that beliefs about the distributive effects of carbon taxation are not consistent with observed transfers. Even when proposed a progressive scheme, most people perceive it as regressive. This result is new as past studies have not jointly assessed and compared people's perceptions and actual distributive consequences of carbon taxation policies.

[5] Among those who declared that the policy was not effective to reduce pollution and fight climate change, 44.8% anticipated price responses of French people consistent with a price elasticity of -0.5 or below for housing energies. For transport fuels, they were 43.2%.

[6] In 2016, French annual emissions in GhG (production based) were equal to 463Mt CO_2e (Source: Ministère de la transition écologique et solidaire, Suivi de la Stratégie Nationale Bas-Carbone). Global annual GhG emissions in 2017 were 53.5 GtCO_2e (Source: IPCC Emissions Gap Report 2018).

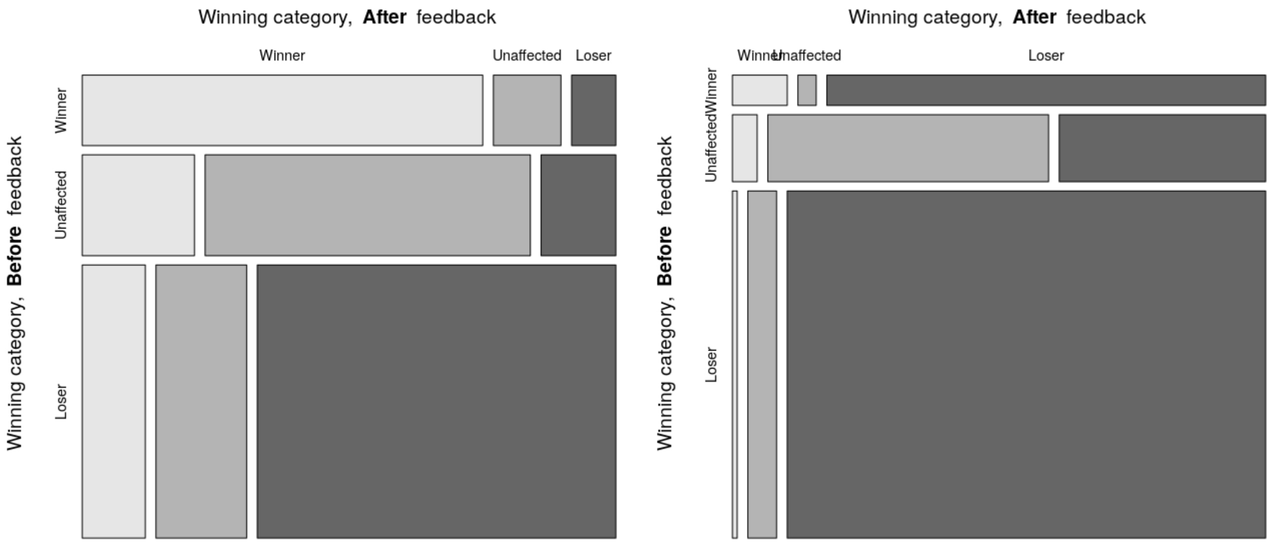
4 Are beliefs well anchored?

The previous section has shown that people's low acceptance of carbon tax and dividend policy coincided with biased beliefs about the basic properties of the scheme. As knowledge about these properties has been shown critical for acceptance [TODO:ref], it is important to assess to what extent beliefs are well anchored. In the following we test respondents' reaction to information about their expected individual gains, tax environmental effectiveness and progressivity. If their biased views simply reflect a lack of knowledge, we should expect them to revise their beliefs after new information is provided. We show that people update less than they should, indicating anchored biased beliefs.

4.1 Beliefs about self-interest

Raw results Figure 3 and Tables VIII and IX in appendix report subjective winning categories before and after the feedback on the objective winning category. Among those expected to win, only 16% initially think they would. After giving a "win" feedback, the share goes up to only 25%, far from the expected 83% of winners in this group. Among the 60% of winners who initially thinking they would lose, 70% do not change their mind, 18% turn to "unaffected", and only 12% agree they would win. Oppositely, among those who receive a "lose" feedback, 78% initially think they would indeed lose. This proportion increases to 86% after the feedback, with 12% unaffected and 3% expecting to win. We observe that respondents revise less their belief when they feel "unaffected", indicating that some of them may have misunderstood this category for "I don't know".

Conservative updating Among the 70% of respondents who should have corrected their beliefs, only 18% did it. This tendency not to rectify one's belief is driven by respondents who mistakenly think they lose. Such anchoring of beliefs implies that either these respondents do not trust our information, either they are not Bayesian. Indeed, assuming that these respondents believe our claim that in five out of six cases our feedback is correct, they would have to believe their situation to be unreasonably special as compared to households with similar energetic characteristics (which could happen if e.g. they heat their house at 27°C). Alternatively, these respondents could share very strong priors regarding their losses, meaning that they think *we* are biased instead of trusting our information and realizing the bias is theirs.



(a) Winners (76.9%)

(b) Losers (23.1%)

Figure 3: Transition matrix among simulated...

Table III: Share of respondents with new beliefs aligned with feedback

	Feedback:	
	$\widehat{\Gamma} > 0$ (76.9%)	$\widehat{\Gamma} < 0$ (23.1%)
Initial belief winner ($G > 0$) (14.0%)	78.8% [73.2% ; 83.4%]	81.5% [65.0% ; 91.3%]
Initial belief unaffected ($G = 0$) (21.7%)	21.6% [17.6% ; 26.2%]	44.9% [33.5% ; 56.8%]
Initial belief loser ($G < 0$) (64.3%)	12.2% [10.3% ; 14.5%]	93.9% [90.9% ; 96.0%]

NOTE: *e.g. 12.2% of estimated winners ($\widehat{\Gamma} > 0$) who felt loser ($G < 0$) update correctly to $G^F > 0$.*

Evidence of asymmetric updating Among the 46% of respondents who believed to be losers although they are expected to win, only 12% corrected their belief. Conversely, 82% corrected their belief among losers who thought they would win. There are several ways to show rigorously that updating occurs asymmetrically, i.e. that winners do not correct as much as losers. To handle the notion of *correct updating*, we define a variable U which equals $+1$ if the respondent adopts a feedback that invalidates their initial belief, -1 if s-he updates against the feedback that confirms it, or 0 if s-he does not update. Over the sub-sample of respondents who should have updated, we regress the *correct updating* U over the initial belief not to lose:

$$U_i = \delta_0 + \beta_U G_i + \epsilon_i \,|\, \dot{G}_i = -\widehat{\Gamma}_i,$$

The high value for β_U reported in column (1) of Table IV proves that those who initially think they win update significantly more than those who do not. Reciprocally, we can regress U on the winning category after the feedback, over the same sub-sample of respondents who should have updated:

$$U_i = \delta_0 + \beta'_U G_i^F + \epsilon_i \,|\, \dot{G}_i = -\widehat{\Gamma}_i$$

Again, β'_U is significantly above 0 (see column (3) of Table IV), suggesting a bias towards loss when updating. Indeed, among those who should have updated, those who end up as winner are disproportionately more correct in thinking so than those who switch or stay as losers. Many other specifications have been tested, depending on how unaffected are treated and whether controls are included or not, and they all confirm a win/lose asymmetry in updating.

Possible explanations for asymmetric updating At least two reasons can explain the asymmetry in updating. First, respondents who think they lose may feel more certain than those who think they win. Then, they would rationalize our invalidation by assuming they belong to the one out of six cases who lose despite our 'win' feedback. Conversely, respondents who mistakenly think they win would more often revise their weaker belief. Second, respondents could react differently to different signals, due to a psychological bias towards loss. This tendency to disproportionately believe to lose contrasts with the literature that shows that people revise more often their belief when they receive good news than bad news. Here, it seems that on the contrary, people update more when they receive bad news (i.e. when they learn to be losers).

Table IV: Asymmetric updating of winning category

	Correct updating (U)			
	(1)	(2)	(3)	(4)
Constant	0.120***	−0.400**	0.002	−0.294**
	(0.012)	(0.163)	(0.009)	(0.115)
Winner, before feedback ($\dot{G}$)	0.695***	0.629***		
	(0.078)	(0.080)		
Winner, after feedback ($\dot{G}^F$)			0.940***	0.930***
			(0.023)	(0.024)
Among: invalidated	✓	✓	✓	✓
Includes controls		✓		✓
Observations	1,365	1,365	1,365	1,365
R^2	0.055	0.127	0.540	0.569

Note: *p<0.1; **p<0.05; ***p<0.01

4.2 Beliefs about environmental effectiveness

...

4.3 Beliefs about progressivity

...

5 Motives for acceptance

Our results clearly indicate that, as of today, a carbon tax is unlikely to be accepted in France. However, we have also shown that people largely display wrong perceptions about the true effects of the policy. Most of them overestimate the negative impact on their purchasing power, think that the policy is regressive, and do not see it as environmentally effective. In this section we examine to what extent the low acceptance rate reflects true preferences or wrong perceptions. The question we indirectly address is whether correcting biased beliefs would be sufficient for a carbon tax to be accepted.

5.1 Self-interest

Identification challenge While three quarters of the respondents are expected to win from a carbon tax and dividend, 62% of these winners consider they would not win and disapprove the policy. We want to estimate to what extent knowing they would win would lead them to approve the reform. Because respondents thinking they would win might differ in many respects from those thinking they would not, we cannot simply regress approval on perception of winning.

Main identification strategy In order to identify the effect *ceteris paribus* of self-interest on acceptance, we exploit exogenous variations in gains and losses. To do so, we consider a tax increase with targeted compensation, where respondents are randomly affected to a compensation scheme to which they are eligible or not (see section 2.1.2). Our methodology mixes a random discontinuity design (RDD) and an instrumental variable (IV) strategy. Let us denote by $I_{1,i}$ respondent's i income, and by $I_{2,i}$ the income of the (potential) second adult of their household. Let $T_{1,i}$ and $T_{2,i}$ be two binary variables indicating whether these individuals would be eligible to the compensation scheme. We also denote G_i^T a dummy variable equal to 0 if respondent i thinks s-he would lose from the tax with targeted compensation, and 1 otherwise. Similarly, A_i^T is a dummy variable equal to 0 if respondent i disapproves this policy and 1 otherwise. We can then write a two stage least-square model, with the following first stage equation:

$$G_i^T = \alpha_0 + \alpha_1 T_{1,i} + \alpha_2 T_{2,i} + \sum_{j=1}^{J} \alpha_{j+2}(I_{1,i})^j + \sum_{j=1}^{J} \alpha_{j+2+J}(I_{2,i})^j + \eta_i \quad (1)$$

where higher order terms for income bring more flexibility. We precise that eligibility is defined using income thresholds c_i that are randomly allocated to households (see section 2.1.2):

$$T_i = \begin{cases} 0, & \text{if } I_i > c_i \\ 1, & \text{otherwise} \end{cases} \quad (2)$$

Finally, the second stage writes:

$$A_i^T = \beta_0 + \beta_1 \widehat{G}_i^T + \sum_{j=1}^{J} \beta_{j+2}(I_{1,i})^j + \sum_{j=1}^{J} \beta_{j+2+J}(I_{2,i})^j + \epsilon_i \quad (3)$$

where $\widehat{G_i}^T$ denotes the fitted value of G_i^T from the first stage regression. As can be seen from first stage results in appendix, eligibility of both respondents and second adults are positively correlated with beliefs of winning, so both instruments are not weak. The exclusion restriction can be written as $Cov(T, \epsilon \,|\, I_0, I_1) = 0$, i.e. that conditional on income, being eligible affects approval solely through beliefs of winning. The RDD procedure employed in the first stage ensures that this is the case: conditional on income, being eligible or not is random, and eligibility should affect acceptance only through self-interest.

Alternative specifications for robustness checks To further ensure the robustness of the results, we estimate several alternative specifications. First, we run the same RDD + IV design adding control variables (specification (2)). In particular, we control for initial acceptance of the tax and dividend policy (a question asked before proposing targeted compensation) as this should explain most of the variation in the dependent variable. As the main specification exploits exogenous variations in the likelihood to win, we nonetheless expect these controls to have no effect on the results. Second, we compare our results with a simple OLS where we control for relevant variables (3). Third, we use a probit model (4), and combine it with our IV strategy in a biprobit model (5) in order to ensure that imposing linearity does not bias the results. As the independent variable of interest is a dummy, we expect the difference to be limited. Finally, we exploit a methodology similar to the main specification but applied to the feedback (6). Indeed, as our estimation for this feedback is a continuous variable $\widehat{\gamma}$, but the feedback itself is a binary variable $\widehat{\Gamma}$, we run a RDD to predict the belief of winning after feedback G^F. We then exploit these conditionally random variations to explain acceptance A^F. This alternative two stage least square writes:

$$G_i^F = \alpha_0 + \alpha_1 \widehat{\Gamma}_i + \sum_{j=1}^{J} \alpha_{j+1} (\widehat{\gamma}_i)^j + \eta_i \tag{4}$$

$$A_i^F = \beta_0 + \beta_1 \widehat{G}_i^F + \sum_{j=1}^{J} \beta_{j+1} (\widehat{\gamma}_i)^j + \epsilon_i \tag{5}$$

where $\widehat{G}_i^F$ denotes the fitted value of G_i^F from the first stage regression.

Results Table V provides the results for each of the six specifications. First stage regression results are given in appendix. Overall, the estimated effect of self-interest is very similar across specifications.

They all consistently indicate that believing to win increases acceptance by about 50 percentage points (p.p.).

Table V: Effect of self-interest on acceptance

	Targeted Acceptance (A^T)				Feedback Acceptance (A^F)
	IV		*OLS*	*logit*	*IV*
	(1)	(2)	(3)	(4)	(5)
Believes does not lose	0.503***	0.543***	0.440***	0.428***	0.438***
	(0.089)	(0.088)	(0.014)	(0.018)	(0.066)
Initial tax Acceptance (A^I)		0.343***	0.362***	0.2721***	0.460***
		(0.034)	(0.026)	(0.022)	(0.041)
Controls: Incomes	✓	✓	✓	✓	✓
Controls: Estimated gain		✓	✓	✓	✓
Controls: Target of the tax	✓	✓	✓	✓	
Observations	3,002	3,002	3,002	3,002	1,968
R^2	0.031	0.302	0.469		0.491

Note: *p<0.1; **p<0.05; ***p<0.01

Note: Standard errors are reported in brackets. For logit, average marginal effects are reported instead of coefficients.

The effect of confidence in beliefs The first five specifications estimate the effect of belief of self-interest for the tax with targeted compensation, while the sixth one concerns the belief after feedback. Using OLS or probit, one can also look at the effect of self-interest using initial acceptance, i.e. before the feedback. This specification does not enable to use our powerful control for initial tax acceptance, but one can still control for other variables such as beliefs about environmental effectiveness, incomes, estimated net transfers and size of urban unit. The results show that believing to win increases acceptance by about 30 p.p. This estimated effect is significantly lower than what was found previously. From the findings of the previous section, we interpret this as a result of the low confidence in one's belief at the initial question on winning category. As we have shown in the previous section, among respondents who initially answered they would win and received a contradictory signal, 84% changed their mind. At later stages of the survey, both the larger amount transferred with targeted compensation the feedback given should have strengthened people's confidence relative to their initial answer, and thus increase the effect on acceptance of their perceived self-interest. This last result further motivates the need to convince people as much as possible about the true incidence a carbon tax policy and dividend on their purchasing power. It also indicates that our previous results could still be lower bounds on the true effect, if people beliefs about their gain remain uncertain at these later stages of the survey.

5.2 Environmental effectiveness

Main identification strategy One of the strongest barriers to carbon tax implementation is a widespread perception of environmental ineffectiveness. Our objective is therefore to assess to what extent learning about the environmental benefits of the tax could increase acceptance. To identify this effect, we estimate several specifications. The main specification is a two-stage least squares (2SLS) where the first stage uses random information to explain beliefs about environmental effectiveness, while the second stage regress acceptance on the fitted exogenous variations in these beliefs. These exogenous information are of two types: information about the severity of climate change and/or air pollution randomly displayed at the beginning of the survey, and a simple statement that "scientists agree that carbon tax is effective to reduce pollution" right before asking respondents for their perception about its effectiveness. If we denote Z_{CC} the information on climate change, Z_{PM} the one on particulate matters, Z_T the information about the scientific consensus, and EE a dummy variable equal to one if the respondents thinks the policy is environmentally effective, then we can write a 2SLS model as follows:

$$EE_i = \alpha_0 + \alpha_1 Z_{CC,i} + \alpha_2 Z_{PM,i} + \alpha_3 (Z_{CC,i} \times Z_{PM,i}) + \alpha_4 Z_{T,i} + \alpha \cdot \mathbf{C_i} + \eta_i \tag{6}$$

$$A_i = \beta_0 + \beta_1 \widehat{EE}_i + \beta \cdot \mathbf{C_i} + \epsilon_i \tag{7}$$

where $\mathbf{C_i}$ is a set of control variables for individual i. This specification overcomes potential endogeneity issues, but estimates a local average treatement effects (LATE) on a sub-population whose preferences regarding environmental policies could differ from the rest of the population. Our other specifications might not be as purely exogenous, but enable to estimate a non-local effect. Also, as we have previously shown that people's responses to these information are limited, the instruments used are not strong. Other specifications are therefore useful to get tighter confidence intervals.

Alternative specifications for robustness checks Our secondary specifications include an OLS where we control for relevant variables (4), a probit model (5) and a biprobit that mixes the probit model with our main IV procedure (6). In order to further discuss the heterogeneous magnitude of the effect, we estimate the IV with informations on climate change and on particulate matters as sole instruments (i.e. without information on the effectiveness of the tax). In this case, the "compliers" are the ones who changed their mind about the effectiveness of the tax because of information about the gravity of the environmental problem. Their position with respect to the policy could then differ substantially from that of other people.

Results Table **??** reports the results. The results of first stage regression are given in appendix. The LATEs estimated with our 2SLS specifications are very high. On average, the acceptance of respondents that have been convinced from our information that the policy is environmentally effective are about 60 p.p. higher. This effect is statistically significant at the 5% level. When only information on climate change and/or particulate matters are provided, the estimated effect is even higher. The coefficient becomes 1.41 and is therefore out of bounds although not statistically different from 1. It suggests that the effect is much stronger for the sub-population of individuals that were convinced from the information that the tax is effective. Thus, when beliefs about the severity of environmental issues are revised upward, the perceived effectiveness of carbon taxation has a very large and positive effect on its acceptance. While informing people that carbon taxation is effective may induce them to think so, the effect on acceptance is weaker. Finally, instrumenting only by the information about the tax effectiveness, the results are not statistically significant anymore: taken alone, this instrument is too weak.

Turning to OLS and Probit specifications, the results indicate that everything else being equal, thinking that the policy is effective increases acceptance by more than 40 p.p. (42.6 with OLS, 45.4 with Probit). Although substantially lower than the LATE estimated with our 2SLS specifications, this effect remains large and lies in the 95% confidence interval of the main 2SLS specification.

Table VI: Effect of believing in environmental effectiveness on acceptance

	Tax Acceptance (A^I)					Tax Approval ($\dot{A}^I$)
	IV	*IV*	*OLS*	*logit*	*IV*	*IV*
	(1)	(2)	(3)	(4)	(5)	(6)
Environmental effectiveness: not 'No'	0.521*	0.461**	0.413***	0.398***		0.421**
	(0.298)	(0.228)	(0.015)	(0.018)		(0.199)
Environmental effectiveness: 'Yes'					0.561*	
					(0.313)	
Instruments: info E.E., C.C. & P.M.	✓	✓			✓	✓
Controls: Socio-demographics		✓	✓	✓		
Observations	3,002	3,002	3,002	3,002	3,002	3,002
R^2	0.001	0.217	0.378		0.001	0.001
Note:						*p<0.1; **p<0.05; ***p<0.01

NOTE: Standard errors are reported in brackets. For Probit and Biprobit, marginal effects at the mean are reported instead of coefficients.

5.3 Progressivity

Identification challenge and strategies We propose two identification strategies relying on such instrumental variable approaches to identify the effect of learning about the progressivity of the policy, and find a significant effects on acceptance. We then turn to more standard OLS and probit regressions where we control for relevant variables.

Results ...

Table VII: Effect of beliefs over progressivity on acceptance

	Tax Acceptance (A^I)				Tax Approval ($\dot{A}^I$)	
	OLS		*logit*	*OLS*	*OLS*	
	(1)	(2)	(3)	(4)	(5)	(6)
Progressivity: not 'No'	0.269***	0.380***	0.255***		0.093***	
	(0.022)	(0.022)	(0.024)		(0.017)	
Progressivity: 'Yes'				0.116***		0.151***
				(0.028)		(0.020)
Controls: Socio-demo, energy	✓		✓	✓	✓	✓
Observations	1,444	1,444	1,444	1,444	1,444	1,444
R^2	0.328	0.166		0.267	0.207	0.222

Note: *p<0.1; **p<0.05; ***p<0.01

5.4 Cumulative effect

Results ...

Correcting beliefs ensure large approbation ...

6 Conclusion

References

A. Baranzini & S. Carattini. Effectiveness, earmarking and labeling: testing the acceptability of carbon taxes with survey data. *Environmental Economics and Policy Studies*, 2017.

R. Bénabou & J. Tirole. Self-Confidence and Personal Motivation. *The Quarterly Journal of Economics*, 2002.

R. Brannlund & L. Persson. To tax, or not to tax: preferences for climate policy attributes. *Climate Policy*, 2012.

A. L. Bristow, M. Wardman, A. M. Zanni, & P. K. Chintakayala. Public acceptability of personal carbon trading and carbon tax. *Ecological Economics*, 2010.

S. Carattini, M. Carvalho, & S. Fankhauser. Overcoming public resistance to carbon taxes. *Wiley Interdisciplinary Reviews: Climate Change*, 2018.

A. Coutts. Good news and bad news are still news: experimental evidence on belief updating. *Experimental Economics*, 2018.

T. Douenne. The vertical and horizontal distributive effects of energy taxes:. *FAERE Working Paper*, 2018.

S. Dresner, L. Dunne, P. Clinch, & C. Beuermann. Social and political responses to ecological tax reform in Europe: an introduction to the special issue. *Energy Policy*, 2006.

S. Dresner, T. Jackson, & N. Gilbert. History and social responses to environmental tax reform in the United Kingdom. *Energy Policy*, 2006.

W. Edwards. Conservatism in human information processing. In *Formal representations of human judgement*. Wiley, New York, b. kleinnmutz edition, 1968.

D. Eil & J. M. Rao. The Good News-Bad News Effect: Asymmetric Processing of Objective Information about Yourself. *American Economic Journal: Microeconomics*, 2011.

S. Kallbekken & H. Sælen. Public acceptance for environmental taxes: Self-interest, environmental and distributional concerns. *Energy Policy*, 2011.

S. Kallbekken, S. Kroll, & T. L. Cherry. Do you not like Pigou, or do you not understand him? Tax aversion and revenue recycling in the lab. *Journal of Environmental Economics and Management*, 2011.

D. Klenert, L. Mattauch, E. Combet, O. Edenhofer, C. Hepburn, R. Rafaty, & N. Stern. Making carbon pricing work for citizens. *Nature Climate Change*, 2018.

H. Sælen & S. Kallbekken. A choice experiment on fuel taxation and earmarking in Norway. *Ecological Economics*, 2011.

P. C. Stern, T. Dietz, & L. Kalof. Value Orientations, Gender, and Environmental Concern. *Environment and Behavior*, 1993.

P. Thalmann. The Public Acceptance of Green Taxes: 2 Million Voters Express Their Opinion. *Public Choice*, 2004.

Appendices

A Raw data

A.1 Perception of net gains

...

A.2 Estimation for feedback

A.2.1 Formulas to compute monetary effects of carbon tax policy

In order to compute the monetary impact of carbon tax increase, we decompose current energy expenditures $E(\tau)$ as a product of their current price $P(\tau)$ and the current level of quantities consumed $Q(\tau)$, each being a function of the excise tax τ to which the carbon tax adds[7]:

$$E(\tau) = P(\tau)Q(\tau)$$

All variations in expenditures can then be expressed as:

$$\frac{dE}{E}(\tau) = \frac{dP}{P}(\tau) + \frac{dQ}{Q}(\tau)$$

from which we can write the effect of a price change on quantities consumed:

$$Q(\tau') = Q(\tau)(1 + e\frac{dP}{P}(\tau))$$

where $e = \frac{dQ}{dP}.\frac{P}{Q}$ is the price elasticity of the energetic good considered, that is here assumed constant. For all energies, the final price can itself be decomposed as:

$$P(\tau) = (p + i\tau)(1 + t)$$

where t is the value added tax (VAT) rate that applies after excise taxes, i the incidence of excise taxes on consumers, and $p + (i - 1)\tau$ the producer price as a function of τ and for a given value of t. When the carbon price changes so that the excise taxes varies from τ to some level τ', we therefore have:

[7] The French carbon tax "Contribution Climat Energie" is a component of existing taxes on energetic products: TICPE for transport and domestic fuels, TICGN for natural gas.

$$\frac{dP(\tau)}{P} = \frac{P(\tau') - P(\tau)}{P(\tau)} = \frac{(p + i\tau')(1+t) - (p + i\tau)(1+t)}{(p + i\tau)(1+t)} = \frac{i(\tau' - \tau)}{p + i\tau}$$

Thus, following a carbon price increase, one can express the associated increase in expenditures for each energy as:

$$E(\tau') - E(\tau) = E(\tau)(1+e)\frac{dP}{P} = E(\tau)(1+e)\frac{i(\tau' - \tau)}{p + i\tau})$$

We can replicate similar calculations to obtain the expected variations in tax revenue T. Starting from its expression - that is the sum of excise taxes and the VAT over this tax - we have:

$$T(\tau) = Q(\tau)\left((1+t)\tau + t[p + (i-1)\tau]\right)$$

from which we obtain:

$$T(\tau') - T(\tau) = Q(\tau)\left(1 + e\frac{i(\tau' - \tau)}{p + i\tau}\right)\left[t(p + (i-1)\tau') + (1+t)\tau'\right] - Q(\tau)\left[t(p + (i-1)\tau) + (1+t)\tau\right]$$

Following the literature, we assumed price elasticities of -0.4 for transport fuels and -0.2 for housing energies. For the tax incidence on consumers we assumed a value of 0.8. These values were used to compute aggregate variations in tax revenue, and determine the level of lump-sum transfer per adult consistent with a budget neutral policy. When asked to estimate the impact of the policy on their own purchasing power, respondents simply had to make an estimation over:

$$E(\tau') - E(\tau) = E(\tau)(1+e)\frac{dP}{P}$$

where for simplicity dP was given for transport fuels, and $\frac{dP}{P}$ for housing energies. Thus, they were not required to make any specific assumption about existing taxes or tax incidence, but simply to estimate their consumption and price elasticity.

A.2.2 Regression to predict gains and losses

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A.2.3 Alternative prediction methods

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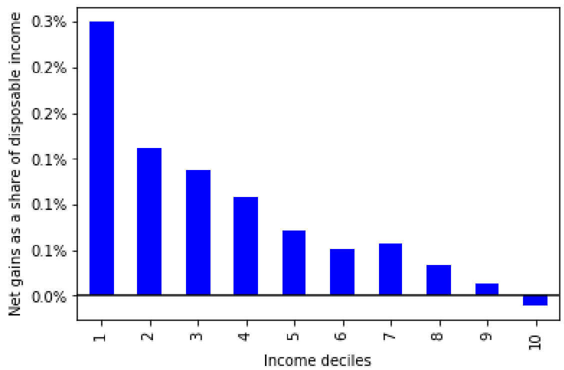
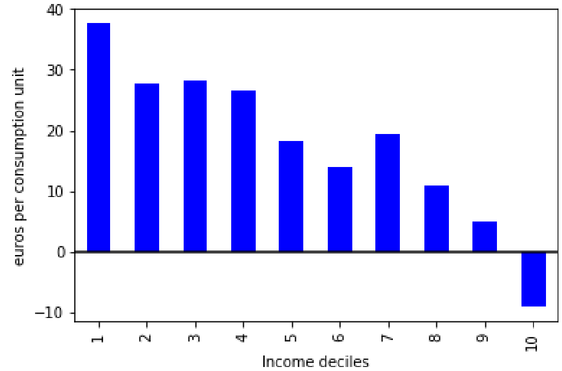
A.3 Distributive effects



(a) as a share of disposable income



(b) per consumption unit

Figure 4: Average cost of the carbon tax and dividend policy, by income decile

B Perceptions

B.1 Self-interest

Table VIII: Transition matrix after telling respondents they are expected to *win* (76.9%)

Before / After	**Winner** (25%)	**Unaffected** (28%)	**Loser** (47%)
Winner (16%)	79%	13%	8%
Unaffected (24%)	22%	63%	15%
Loser (60%)	12%	18%	70%

Table IX: Transition matrix after telling respondents they are expected to *lose* (23.1%)

Before / After	**Winner** (3%)	**Unaffected** (12%)	**Loser** (86%)
Winner (7%)	16%	3%	81%
Unaffected (15%)	5%	50%	46%
Loser (78%)	1%	5%	94%

Table X: Effect of subjective elasticities on perceived environmental effectiveness

	Dependent variable:			
	Environmental effectiveness			
	(1)	(2)	(3)	(4)
Price elasticity housing	−0.071**		−0.071**	
	(0.035)		(0.035)	
Price elsticity transports		−0.073**		−0.084**
		(0.033)		(0.033)
Income			−0.00000	0.00002*
			(0.00001)	(0.00001)
Size urban unit			0.026***	0.016*
			(0.009)	(0.009)
Age			−0.002***	−0.003***
			(0.001)	(0.001)
Domestic fuel			−0.003	−0.111**
			(0.043)	(0.049)
Natural gas			−0.035	−0.032
			(0.026)	(0.027)
Diesel			−0.110***	−0.138***
			(0.025)	(0.026)
Constant	0.286***	0.335***	0.393***	0.505***
	(0.019)	(0.019)	(0.050)	(0.052)
Observations	1,501	1,501	1,501	1,501
R^2	0.003	0.003	0.035	0.050
Adjusted R^2	0.002	0.003	0.031	0.045
Residual Std. Error	0.464 (df = 1499)	0.482 (df = 1499)	0.457 (df = 1493)	0.472 (df = 1493)
F Statistic	4.108** (df = 1; 1499)	4.764** (df = 1; 1499)	7.849*** (df = 7; 1493)	11.114*** (df = 7; 1493)

Note: *p<0.1; **p<0.05; ***p<0.01

B.2 Environmental effectiveness

C Estimation acceptation motives

C.1 Two stage least squares: first stage results

Table XI: First stage regressions results for self-interest

	Believes does not lose		
	Targeted tax (G^T)		After feedback (G^F)
	(1)	(2)	(3)
Constant	0.271***	0.214	−0.116
	(0.039)	(0.147)	(0.163)
Transfer to respondent (T_1)	0.270***	0.228***	
	(0.028)	(0.028)	
Transfer to spouse (T_2)	0.161***	0.181***	
	(0.024)	(0.026)	
$T_1 \times T_2$	−0.192***	−0.164***	
	(0.038)	(0.037)	
Simulated winner ($\widehat{\Gamma}$)			0.347***
			(0.028)
Initial tax Acceptance (A^I)		0.174***	0.372***
		(0.033)	(0.038)
Controls: Incomes	✓	✓	✓
Controls: Estimated gain		✓	✓
Controls: Target of the tax	✓	✓	
Observations	3,002	3,002	1,968
R^2	0.081	0.178	0.295

Note: *p<0.1; **p<0.05; ***p<0.01

C.2 Additional specifications

Table XII: First stage regressions results for environmental effectiveness

	Environmental effectiveness		
	not 'No'		'Yes'
	(1, 6)	(2)	(5)
Constant	0.289***	0.556***	0.119***
	(0.019)	(0.135)	(0.015)
Info on Environmental Effectiveness (Z_{EE})	0.043**	0.062***	0.042***
	(0.017)	(0.017)	(0.014)
Info on Climate Change (Z_{CC})	0.044*	0.037	0.033*
	(0.024)	(0.023)	(0.019)
Info on Particulate Matter (Z_{PM})	0.039	0.012	0.025
	(0.024)	(0.023)	(0.019)
$Z_{CC} \times Z_{PM}$	−0.040	−0.014	−0.012
	(0.035)	(0.033)	(0.027)
Controls		✓	
Observations	3,002	3,002	3,002
R^2	0.003	0.121	0.005
Note:	*p<0.1; **p<0.05; ***p<0.01		