YELLOW VESTS, PESSIMISTIC BELIEFS, AND CARBON TAX AVERSION*

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Abstract

Using a representative survey, we find that after the Yellow Vests movement, French people would largely reject a Tax & Dividend policy, i.e. a carbon tax whose revenues are redistributed uniformly to each adult. However, they overestimate their net monetary loss, wrongly think the policy is regressive, and do not perceive it as environmentally effective. We show that changing people's beliefs about the tax incidence and effectiveness can largely increase support. Yet, beliefs change little following our informational treatments. Indeed, if overly pessimistic beliefs cause tax rejection, they also result from it through motivated reasoning, which manifests what we define as "tax aversion".

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

Keywords: Climate Policy; Carbon tax; Beliefs; Preferences; Tax aversion

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1 Introduction

The French government had initially committed to an ambitious trajectory for the price of carbon.[1] 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 turnaround in French climate policy is the direct consequence of the popular protest of the "Yellow Vests", which started against the carbon tax.[2] Among several factors, the negative impact of the tax on households' purchasing power has certainly been a key driver of public's discontent. The increasing revenues from the carbon tax were mostly used to fund the budget rather than redistributed to households, raising concerns over the distributive effects of the policy. In order to tackle the negative impact of carbon taxation on households' purchasing power, economists have proposed a scheme known as "Tax & Dividend", i.e. a carbon tax whose revenue is redistributed uniformly to each adult. This strategy has recently been supported by 3,354 American economists in The Wall Street Journal, "To maximize the fairness and political viability of a rising carbon tax". Implicitly, it is therefore assumed that with a design that ensures that the properties of the tax are aligned with people's *preferences* one should be able to generate support for it. But is it really sufficient? In this paper, we show that to understand the link between the properties of a policy and its support, one has to account for a critical ingredient: *beliefs*.

The objective of this paper is to understand how beliefs about a policy form and then determine attitudes towards it. The recent events undoubtedly make the French carbon tax an interesting case study. In order to explain French attitudes towards carbon taxation, we conducted a survey on a representative sample of 3,002 French households. We focus on a

[1] More precisely, the "Contribution Climat-Énergie" is a *sectoral* carbon tax specific to fossil fuels.

[2] Following a massive petition against rising gasoline prices in November 2018, hundreds of thousands of people started protesting. They would wear their recognizable fluorescent clothing and gather on roundabouts and tolls every day, and demonstrate in Paris each Saturday. The Yellow Vests express a general concern for their purchasing power as well as discontent for French elites and institutions.

"Tax & Dividend" carbon tax with uniform lump-sum compensation, which allows one to specify clearly the distributive effects of the policy, in contrast to the policy abandoned by the government. The reform is approved by only 10% of respondents and disapproved by 70% (the rest do not know or do not want to answer). We analyze the perceptions of 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 regarding the impacts on one's purchasing power to the objective distribution computed using official households' survey data. This comparison shows that people largely overestimate the tax incidence. For instance, while 70% of households are expected to win from this policy, only 14% think they would. Similarly, while the scheme proposed in our survey is progressive, a large majority of individuals perceive it as regressive. In addition, a majority of respondents do not believe that such a policy would reduce pollution and fight climate change. Using information reported over their energy equipment and usage, we are able to compute a respondent-specific estimation of the tax incidence on their purchasing power. This estimation enables us to look at the heterogeneity in what we call *biases* about the perceived tax incidence. We find that the people most opposed to the policy, and in particular those supportive of the Yellow Vests, are the most biased, i.e. the most inclined to over-estimate their losses. Thus, one may wonder whether pessimistic beliefs lead to policy rejection or if the causality goes in the other direction.

To disentangle the effect of initial beliefs on attitudes towards the policy from the reverse effect of attitudes on perceptions, we investigate the effect of providing new information to respondents through random treatments. Respondents randomly receive (or not) a piece of information about the progressivity and/or about the effectiveness of the policy, as well as the customized information — derived from our respondent-specific estimation — on whether their household is expected to win or lose from the policy. We also specify that this latter information is correct in five cases out of six, a probability that we carefully estimated out-of-sample. A first observation is that our treatments generally fail to change pessimistic beliefs. For example, among those advantaged by the reform who pessimistically believe they would lose, only 12% are convinced that they would gain when we disclose our estimation to them.

Worse, respondents revise their beliefs in an asymmetric way, giving more weight to new information when it shows they would lose from the reform, i.e. when it provides them with arguments against the tax. We also find evidence strongly supportive of motivated reasoning[3] in the formation of beliefs, as those who already approved of the reform are more likely to correctly revise their belief, while those most opposed to it such as supporters of the Yellow Vests tend to discard new information unless it goes against the tax. Moreover, we find that this phenomenon is accentuated among highly educated people, suggesting that it stems from an adaptive advantage rather than a cognitive deficiency.

We use the random display of information as instruments to estimate the causal effect on the policy support of holding certain beliefs (measured as binary variables). In the case of self-interest (taken as one's beliefs about winning or losing purchasing power from the policy), we supplement these treatments by testing the support for a different Tax & Dividend whose compensation is targeted to people with incomes below a threshold that varies between respondents to create exogenous variations in eligibility. The method we use in this case is noteworthy, as it creates random variation in beliefs of winning around the eligibility thresholds and enables us to estimate the causal effect of this belief using a fuzzy regression discontinuity design. Our results indicate that convincing people about the actual incidence and effectiveness of the policy could lead to majority support. Indeed, we find that self-interest has a large effect on the support for the policy: the belief that one does not lose from it increases the acceptance rate by 50 p.p. Similarly, believing that the tax is environmentally effective increases the approval rate of the reform by above 40 p.p. We also provide non-causal evidence that believing in the progressivity of the scheme has a large effect on the support. Overall, these results suggest that rejection of carbon taxation does not commonly result from clashing principles, such as a disinterest in climate or a dislike of price instruments, but rather from overly pessimistic beliefs about the properties of the reform. To the extent beliefs are formed endogenously in a motivated way, people's biases gain inertia,

[3]Motivated reasoning is the "tendency to find arguments in favor of conclusions we want to believe to be stronger than arguments for conclusions we do not want to believe" (Kunda, 1990).

so that new information might only push their attitude in one direction.[4]

The contribution of this paper is two-fold. First, it contributes to a recent literature that has emerged to understand the political economy of climate policies, as this issue is becoming critical in the public debate. For a thorough review of this literature, we refer the reader to Carattini et al. (2018), and also suggest the more synthetic Klenert et al. (2018), as well as Millner & Ollivier (2016) for a review of the political obstacles to environmental policies. Stern et al. (1993) is an early work proposing and testing a model of attitudes 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 beliefs about consequences on self-interest are 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, Swedish, and Swiss respondents respectively, Bristow et al. (2010), Brannlund & Persson (2012), and Carattini et al. (2017) document a higher approval rate 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, Kallbekken & Sælen (2011) show that self-interest matters for acceptance, but less than concerns for environmental effectiveness or distributional effects. On US data, Anderson et al. (2019) argue that ideology explains most of the support for carbon taxation, and suggest that this effect would dominate that of self-interest.

In the present paper, we also study how acceptance depends on these three motives (i.e. self-interest, perceived environmental effectiveness and progressivity). We contribute to the literature by providing robust evidence for causal effects where past studies essentially show

[4]The "campaign effect" documented by Anderson et al. (2019) (in the case of referenda in the US state of Washington) is an example of how support for a carbon tax can decrease substantially after it enters the public debate. It may explain why acceptance of an increase in the carbon tax plummeted with the Yellow Vests movement, down from a level of 48% (ADEME, 2018) in the middle range of other countries' (Brechin, 2010). This effect confirms that the French carbon tax may be an insightful case study to understand what could happen in other countries when a controversial policy is publicly debated.

correlations, often relying on proxies such as fuel consumption to proxy self-interest (e.g. Thalmann, 2004; Kallbekken & Sælen, 2011; Anderson et al., 2019). In contrast, we do not assume that people are fully rational nor have perfect information. Thus, our methodology offers a novel look at the political economy of climate policies, as it allows one to disentangle erroneous *beliefs* from pure effects of *preferences*.[5] The paper also quantifies biases regarding the costs of the carbon tax. To our knowledge, it is the first study that compares subjective beliefs and objective data about the private costs that arise from carbon taxation. Given the intense public debate over the incidence of such a policy, identifying and measuring the discrepancy between actual impacts and their subjective perception is critical.

Beyond the case of carbon pricing, our paper contributes to the literature on the formation of political beliefs. Recent research has shown how beliefs on inequality and social mobility affect people's attitudes regarding distributive policies (e.g. Cruces et al., 2013; Kuziemko et al., 2015; Alesina et al., 2018). Our paper adds to this literature by investigating the relationship between beliefs and attitudes on climate policies. It also goes further than previous studies by identifying a bi-directional relationship as we show that not only do beliefs determine attitudes, but attitudes over policies in turn shape beliefs. Indeed, using a representative survey, our paper brings evidence consistent with theories of motivated reasoning (Kunda (1990), see Bénabou & Tirole (2016) for a recent review) that have so far been mostly tested in the lab (e.g. Redlawsk, 2002; Thaler, 2019). In particular, our results support the recent theory of Little (2019) who formalizes motivated reasoning as a way to reconcile an auxiliary belief (one's self-interest in the reform) to a core belief (here, the policy rejection). We believe our results apply beyond the case of carbon taxation, and illustrate more generally the determinants and consequences of tax aversion. Indeed, the few previous definitions of tax aversion (Sussman & Olivola, 2011) are hardly exploitable empirically, as they do not relate the concept to an observable phenomenon. This may contribute to the limited number of papers on this topic (Kallbekken et al., 2011; Kessler & Norton, 2016). Building upon

[5] We take preferences over policies as the mapping from beliefs (on facts) to attitudes (on policies), i.e. how attitudes are determined as a function of beliefs. Conversely, motivated reasoning represents the feedback loop from attitudes to beliefs.

our results, we can define *tax aversion* as a gut rejection of a tax (or taxation in general) that influences beliefs about the tax properties such as its effectiveness, fairness, or sameness with an equivalent measure labeled differently. Our work then shows that tax aversion can be identified through motivated reasoning, by observing that the initial tax rejection impacts how one integrates new information into one's beliefs.

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 impacts of carbon taxation. In Section 4, we study the formation of beliefs and propose several mechanisms to rationalize people's pessimism. In Section 5, we estimate the effects on acceptance of changing people's beliefs about the tax incidence and effectiveness. Section 6 concludes. Further results and methodological complements are reported in the Appendix and in an online Appendix.

2 Context, survey, and data

2.1 Context of the study

The Yellow Vests constitute a singular protest movement: although over-represented within the far left and right, they are supported by a large fraction of the French spanning from across the political spectrum.[6] Thousands of small-scale protests were organized autonomously on social networks, and the movement was remarkably independent from political parties and unions. Before the emergence of the movement, none of the major political parties was campaigning against the carbon tax, and this policy did not trigger specific opposition until the increase in oil prices brought it to the forefront of the debates.[7] The

[6]Table H.1 in online Appendix H provides our respondents' position towards the Yellow Vests depending on their socio-demographics and left-right leaning. It shows that the support for the movement is widespread. People at the center of the political spectrum are the least supportive with still 46% warming the Yellow Vests, vs. 66% for the whole population.

[7]Fuel prices peaked in October 2018. The movement gained momentum at that time, leading to the first massive protest on November 17th.

opposition then quickly gained ground, notably through Facebook where a petition against the tax and a call to protest on roundabouts were largely relayed. These protests initially occurred every day and did not phase-out until December 2018 when the government responded by a set of measures including the abandonment of the carbon tax increases initially scheduled as well as boosts to low wages and modest pensions. The fading movement came to an almost complete halt at the end of April 2019 when the government gave in on some of the demands for more purchasing power and direct democracy (Boyer et al., 2020).

A simple interpretation of these protests could be that French people are far more concerned by their purchasing power than by climate change. Yet, our companion paper documents that a large majority of French people are aware and concerned about climate change and supportive of various climate policies, such as a tax on air travel, green investments or stricter pollution norms (Douenne & Fabre, 2020),[8] and our survey suggests that willingness-to-pay for the carbon tax is similar to that of other countries (see online Appendix K). Instead, French people may just not perceive the carbon as the appropriate policy to tackle climate change. Thus, the present paper sheds light on people's beliefs about the carbon tax, how they form and how they affect the policy support.

2.2 Our survey

2.2.1 Survey data collection

The survey was conducted in February and March 2019, three months after the government decided to abandon the planned increase of the carbon tax. The 3,002 responses were collected through the survey company Bilendi. This company maintains a panel of French respondents whom they can email with survey links. Respondents are paid 3€ 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 cat-

[8]The levels of awareness and concern are similar to those of other countries (Stokes et al., 2015). For instance, 72% know that climate change is anthropogenic, as compared to 66% in the US (Gallup, 2019).

egory (8), size of town (5) and region (9). The quotas are relaxed by 5% to 10% relative to actual proportions for ease of the sampling process. Table A.1 in Appendix A shows that our sample is still extremely representative. Nonetheless, observations are weighted to correct for small differences between sample and population frequencies (e.g. in education). 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. We took several steps to ensure the best possible data quality. Our representative sample was obtained after excluding inattentive and quickest respondents. We confirm in online Appendix L that this sampling restriction does not affect the main results.

2.2.2 The survey

The full survey in French can be seen online,[9] and the translated questionnaire is detailed in online Appendix G. It contains several random branches and treatments that are independent of one another: Figure 2.1 presents in a diagram the sequence of information or treatments (represented by ellipses) and questions (boxes). This section presents in turn each part of the survey.

Priming on environmental issues The survey opens with a brief presentation: three short sentences to welcome the participant, introduce ourselves as "two researchers in social sciences", and say that it will last 15 to 20 minutes. Two blocks of information are then randomly displayed or not: one on climate change and the other on particulate matter. This priming divides the sample into four groups, who receive either one block of information, the other, none, or both of them. The objective of these primings is to see whether providing salient information on the consequences of climate change or air pollution affects respondents' answers later in the survey. Climate change information includes temperature trends for the long-run future, concerning facts on current and expected impacts, and a claim that keeping global warming below 2 °C is technically feasible. Particulates information consists of the estimated impact on French mortality (48,000 deaths per year), life expectancy (9

[9] preferences-pol.fr/doc_q.php#_e

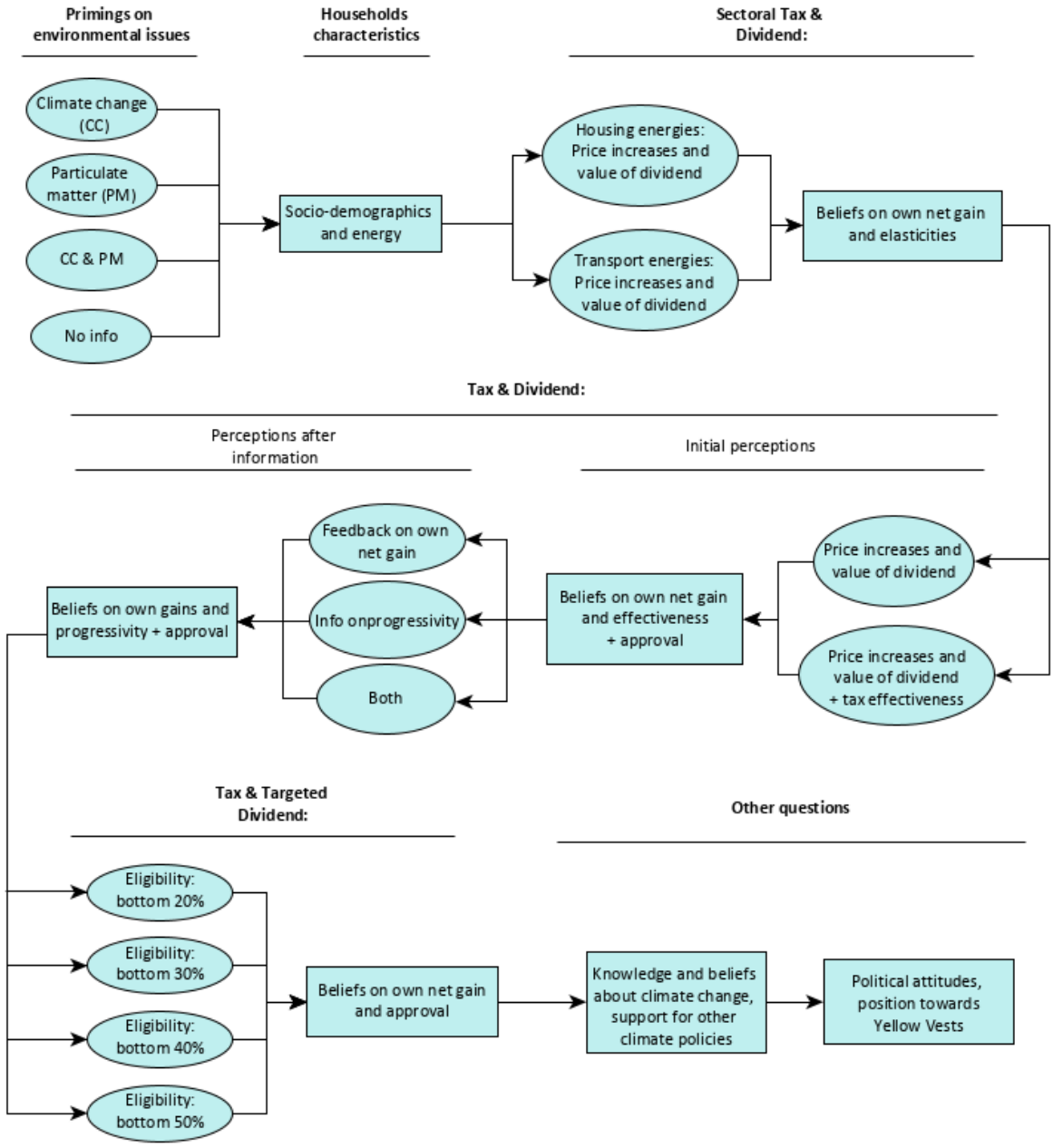


Figure 2.1: Sequence of information or treatments (ellipses) and questions (boxes).

NOTE: The succession of informative treatments and of questions on beliefs and support for different Tax & Dividend policies informs about how beliefs are revised in view of new information, and allows to estimate the causal effects of these beliefs on the policy support.

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 displayed to support

the information.

Household characteristics In addition to the six quotas strata, socio-demographic characteristics include zip code, household structure, income of the respondent and of their household. A block on energy characteristics contains questions that allow us to estimate the impact of a carbon tax increase on housing expenditures (energy source, size of accommodation) as well as on transport expenditures (number of vehicles, type(s) of fuel, distance travelled last year, and average fuel economy). The distributions of answers are much in-line with official statistics, as shown in Table A.2 in Appendix A.

Sectoral Tax & Dividend We first randomly allocate the respondent to one of the two sectors on which the French carbon tax applies: housing *or* transport. They are presented with a specific policy: a sectoral Tax & Dividend, i.e. an increase in housing *or* transport energies taxes that would finance a lump-sum transfer to all adults.[10] We detail the increases in prices that would follow and the value of the dividend they would receive: for the housing energy tax, $+13\%$ for gas and $+15\%$ for domestic fuel together with a yearly transfer of 50€ per adult; for the transport energy tax, $+0.11$€ per liter of gasoline and $+0.13$€/L for diesel with a yearly transfer of 60€ per adult. These figures are equivalent to an increase in the carbon price on these energies by 50€/tCO_2, but we do not mention the name "carbon tax" at this stage as we do not want people to think that it also falls on the other sector. The value of the dividends were obtained such that the policy is budget neutral, and assuming typical price elasticities (see 2.3.1). We present the policy starting with "The government studies..." to capture the effect of distrust in government that could arise in the actual political process.

Then, we ask the respondent whether their household would win, lose, or be unaffected by the reform in terms of purchasing power (win/lose category thereafter). 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

[10] We chose to redistribute per adult instead of per consumption unit to make the scheme more understandable. We limited the number of beneficiaries to two per household to better align with current welfare benefits that depend on the number of consumption units.

proportion of the number of consumption units (c.u.) of their household (as defined by Eurostat).[11] Similarly, households' gains and losses are always expressed per consumption unit in the analysis. The questions were not incentivized. Indeed, Sapienza & Zingales (2013) show that people think that economic experts are too optimistic regarding the carbon tax, so incentivizing the answers could have led respondents to misreport their true beliefs and shift them towards what they think the researchers expect. Finally, to see whether people think the incentive purpose of the tax operates, 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 for the expected decrease in consumption that would follow a 30% increase in the price of heating (or equivalently, an increase of 0.50€/L in fuel prices), among 5 brackets.

Tax & Dividend

Initial perceptions Our main reform of interest is an increase by 50€/tCO_2 of the French carbon tax, that concerns *both* housing and transport.[12] The revenues generated are again redistributed equally, so that each adult receives a yearly lump-sum compensation of 110€. We now explicitly present the reform as an increase in the carbon tax, although as before we do not give the implicit carbon price but rather the effect on energy prices (the same as before, but on both sectors) and the value of the dividend.[13] After describing the reform, a first block of questions elicits the respondent's perceptions. Their subjective net gain in purchasing power is asked in the same manner as for the sectoral tax, with adapted intervals. 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. Finally, we ask: "Would you approve of

[11] For instance, for a single-member household (c.u.=1), the intervals of expected gain are $(0,10)$, $(10,20)$, etc.; while for a childless couple (c.u.=1.5), these intervals are $(0,15)$, $(15,30)$, etc.

[12] Electricity and industries are exempt from the French carbon tax as they are already covered by the EU-ETS.

[13] For the exact phrasing, see question 35 in online Appendix G.

this reform?" and let the respondent choose between "Yes", "No" and "PNR (I don't know, I don't want to answer)".[14] In the following, we say that a respondent *approves* a reform if they respond "Yes", and that they *accept* the reform if they do *not* respond "No". Table I.1 in the online Appendix I describes the rates of support for the Tax & Dividend policies at different stages of the survey.

Perceptions *after information* To assess how beliefs are formed and measure the importance of self-interest and fairness motives in the acceptance of the reform, we then 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 respondents with the previous priming on *progressivity*), we provide customized information explaining that: "In five cases out of 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 travelled with an average consumption of [fuel economy] L for 100 km.)". In Section 2.3.2, that details how we compute each respondent's net gain, we show that our prediction that a household wins or loses is correct in 83% of cases, hence our "five cases out of six".

Then, we again ask for the win/lose category (i.e. if the respondent's household would win, lose or be unaffected by the reform) and for the approval of the reform. Respondents are also asked about the perceived advantages and disadvantages of the policy, including the effect on the poorest households. To the later half of the sample, we explicitly ask right after the treatment on progressivity whether they think the reform would benefit the poorest as most respondents appeared not to believe our information.

Tax & Targeted Dividend In order to disentangle the effect of self-interest from other acceptation motives in Section 5, we then submit to respondents an alternative reform where

[14] In English, "PNR" stands for "Prefer Not to Respond".

not everyone is eligible. More specifically, we propose one of four alternative reforms where the payments, still equal among recipients, are targeted to adults whose income is below some threshold. The four possible thresholds correspond to the 20th, 30th, 40th, and 50th percentile 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).[15] Respondents whose income lies between two thresholds are allocated randomly to a reform defined with one of them. For example, a person at the 25th percentile of the income distribution has one in two chances to face a reform targeted to the bottom 30%, where they are eligible to the dividend, and on in two chances to face a reform targeted to the bottom 20%, where they are not. 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 the household's second adult. 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 2.1 details the income thresholds and dividends of the four variants as well as the proportion of respondents allocated to each of them, along with the proportion one would expect from the *ERFS*. The two sets of figures match almost perfectly, indicating that our sample is representative along the income dimension.

We describe to each respondent the variant they face: the price increases, the income threshold and the value of the dividend; we also specify how many persons would be eligible to the payment in their household. Finally, we ask again respondents for their anticipated win/lose category and their approval.

[15] 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 2.1: 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*

NOTE: This table reads as follows: when targeted people are the ones below the 20th percentile (≤ 20), all adults with an income below 780€/month receive a dividend of 550€/year. 0.356 of our respondents are assigned to this policy (to which they may be eligible or not depending on their income), against 0.349 if our survey was *exactly* representative of the true income distribution of the French population.

Other questions We do not detail the other questions of the survey, because we devote a companion paper to their analysis, Douenne & Fabre (2020). In these questions, we examine opinions on environmental policies, including other ways to recycle the revenues of a carbon tax. We measure the knowledge and perceptions of climate change; ask some specific questions on the influence of climate change on the choice to give birth, and one's willingness to change their lifestyle. We study the use, availability, and satisfaction with public transportation and active mobility. We also ask for political preferences, including position in relation to the Yellow Vests. Finally, we let the respondent express any comment in a text box.

Notations We adopt consistent notations throughout the paper, defined in Appendix B, and recalled throughout the text.

2.3 Official households surveys

In addition to our survey, the paper makes use of three official households surveys produced by Insee: the consumer survey *Budget de Famille* (BdF 2011), the transport survey *Enquête Nationale Transports et Déplacements* (ENTD 2008) and the housing survey *Enquête Logement* (EL 2013). We use these additional datasets for two purposes. First, we use the first two surveys to estimate the distribution of additional fossil fuels expenditures. This in turn provides both an estimate of total revenues from the tax (and hence of the dividend) as

well as an estimate of the *objective* distribution of net gains that allows for a comparison with the *subjective* distribution derived from our survey. Second, we use the housing survey to compute a respondent-specific estimate of the objective net gain. It allows us to measure respondents' bias regarding their net gain and provide them with a customized win/lose feedback. The precision of this estimate is assessed by testing it out-of-sample on the consumer survey. The different steps are explained below.[16]

2.3.1 Eliciting objective aggregates and distributions

Data For the first purpose, we use the database constructed by Douenne (2020) whose objective was to estimate the distributive effects of a carbon tax on French households. It builds on the consumer survey (BdF 2011) that includes over 10,000 households for whom it provides information over all their revenues and expenditures — including their energy bills — together with many socio-demographic characteristics. This survey is matched to the transport survey (ENTD 2008) to correct for short run fluctuations in transport fuels consumption. Such matching is not necessary for housing energies as these already represent consumption over long periods in BdF.[17]

Computing tax incidence and revenues From this combined dataset, we are able to determine the increase in expenditures households would face and compute the total tax revenue to be redistributed lump-sum. We thereby obtain the distribution of households' *objective* net gains in purchasing power implied by the policies proposed. Formally, the net gain γ_h of an household h can be expressed as:

$$\gamma_h = N_h^a \cdot D - \Delta E_h^{transport} - \Delta E_h^{housing} \tag{1}$$

where $D = 110€$ denotes the value of the dividend, N_h^a the number of adults receiving it in this household, and $\Delta E^{transport}$, $\Delta E^{\text{housing}}$ the increases in their energy expenditures. The

[16] Data from National Accounts is used to homogeneously inflate households' sectoral expenditures of each dataset we use in order to make them representative of the most recent trend and comparable across datasets.

[17] For more information about these surveys, see Appendix C.1.

formulas used to compute the three terms on the right hand side are given in Appendix C.2. Our computations use typical elasticities found in the literature on French households: -0.4 for transport and -0.2 for housing, as well as an incidence borne at 80% by consumers.[18]

2.3.2 Computing households' expected net gains

Simulating expected net gains In order to measure each respondent's bias and to provide a customized feedback on their win/lose category, we need to estimate their net gain as expressed by equation (1). Since households are asked about yearly distance travelled and average fuel consumption of their private vehicles, we can directly compute the increase in their transport fuels expenditures $\Delta E^{transport}$. However, we lack their housing energies expenses to evaluate $\Delta E^{housing}$. We therefore need to estimate it based on their energy characteristics. To do so, we use the housing survey *Enquête Logement* (EL 2013) that again provides information on household expenditures in housing energies as well as many demographic and energy characteristics. It enables us to compute $\Delta E^{housing}$ and regress it on household characteristics. The coefficients obtained can then be used to compute $\widehat{\Delta E}^{housing}$ (and thus obtain $\widehat{\gamma}$) for any household. The specification we chose is as follows:

$$\Delta E_h^{housing} = \beta_0 + \beta_1 \chi_h^G + \beta_2 \chi_h^F + \beta_3 \sigma_h + \varepsilon_h \tag{2}$$

where χ_h^G (resp. χ_h^F) is a dummy variable equal to 1 if the household uses gas (res. domestic fuel) for heating, and σ the size of the household's accommodation in square meters. The results are provided in Appendix C.3, where they are shown to be as accurate as the ones obtained from alternative prediction methods and specifications, with the advantage of more robustness to potential misreporting of size of accommodation.

Assessing feedback's accuracy The previous estimation could have also been conducted with BdF data. Still, running this estimation on the housing survey is very useful: it enables us to test the accuracy of our prediction out-of-sample. Indeed, since for households in BdF

[18] These values correspond to the short run uncompensated price elasticities estimated by Douenne (2020), and are in line with previous findings on French households (e.g. Clerc & Marcus, 2009; Bureau, 2011).

data we observe both their energy characteristics and their actual energy bills, we can both calculate directly $\Delta E^{housing}$ and use our prediction to compute $\widehat{\Delta E}^{housing}$. Adding to this the additional costs arising from transport energies and the dividend, we can obtain both their true net gain γ and their estimated one $\widehat{\gamma}$. This allows us to estimate the likelihood of correctly predicting the win/lose category for these households. Because the prediction was made from a different survey than the one on which it was tested, we avoided the risk of over-fitting.

Figure D.1 in Appendix D.2 shows how the probability that our prediction is correct depends on objective gains. For five households out of six, we correctly predict whether their purchasing power would increase or decrease through the policy. We make this ratio symmetrical to balance the shares of overly optimistic and overly pessimistic feedbacks: among households in BdF predicted to win, 83.4% were actual winners, while among those predicted to lose, 83.4% were actual losers. Assuming that the characteristics reported by our respondents are correct, there is no reason to believe that the probability of error is higher or lower when simulations are applied to our survey respondents.[19]

3 Pessimistic beliefs

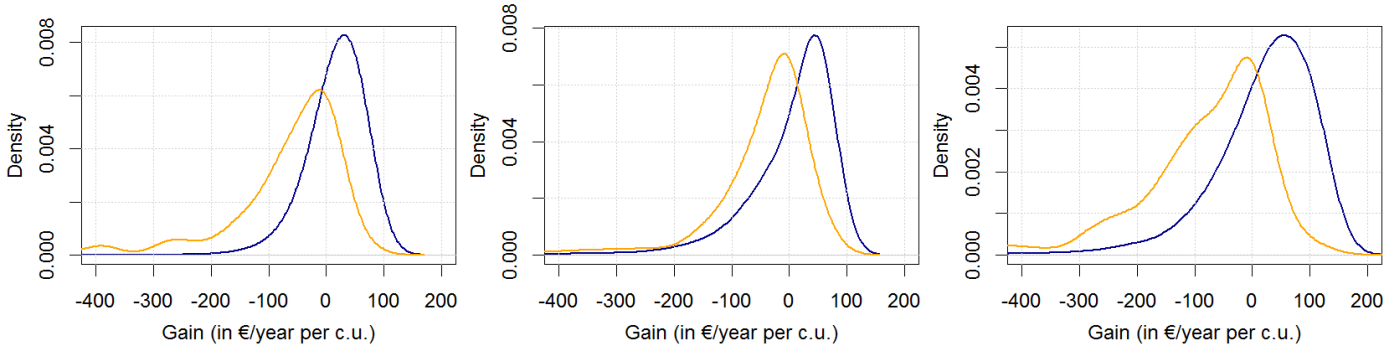
3.1 Self-interest

Over-estimation of policy costs While 70% of households should benefit (in monetary terms) from the compensated carbon tax, only 14% think they would (and 22% see themselves unaffected).[20] Figure 3.1 plots the kernel density of expected net gains for objective data from Insee, and subjective beliefs from our survey. Figure 3.2 compares the CDF of

[19] In particular, a critical assumption is that people correctly reported their distance travelled and the average fuel economy of their vehicles, so that the computation of $\Delta E^{transport}$ is correct. As shown in Table A.1 in Appendix A, the values reported by respondents follow a distribution very similar to the one found in official statistics.

[20] For transport and housing energy taxes, the objective proportions of winners are very similar at respectively 74% and 67%, while the subjective shares are 16% and 17% (with 22% and 30% of unaffected).

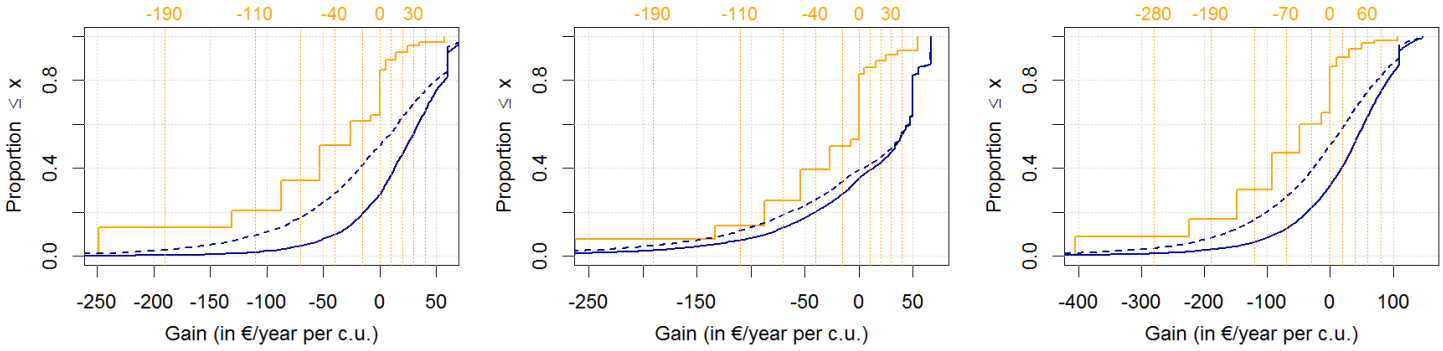
objective vs. subjective net gains.[21] It is evident from these figures that on average, respondents overestimate the cost of the policy, even in the extreme case of perfectly inelastic expenditures. This result holds both for the carbon tax and for partial carbon taxes on transport and housing energies. 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 subjective net gains of respectively −61€, −43€, and −89€. The median gap of 116€ between objective and subjective gains indicates a substantial bias towards loss from typical respondents. This bias is widespread, as we find that 89% of respondents underestimate their gain of purchasing power relative to our household-specific estimation. (The full distribution of respondents' bias is provided in Figure C.2 in Appendix C.3.) This proportion remains as high as 77% when assuming inelastic expenditures, which provides a lower bound on the share who underestimate their net gain in utility.



(a) Transport fuels (b) Housing energies (c) Both

Figure 3.1: Distribution of objective (dark blue) vs. subjective (orange) net gains from our Tax & Dividend.

[21] The subjective intervals are translated into numerical values, assuming that the distribution within each interval is the same as that of Insee data. Within each bin, we draw values that match the actual distribution for the PDF, while we simply take the actual average for the CDF. Among the several methods that we tried to assign numerical values, all realistic ones yield identical results, and we find an overestimation of policy costs even in the most conservative one (taking the maximal bounds of intervals).



(a) Transport fuels (b) Housing energies (c) Both

NOTE: Dashed blue lines represent distributions of objective gains in the extreme case of totally inelastic expenditures. Vertical dotted orange lines show the limits of intervals answers of subjective gains.

Figure 3.2: Cumulative Density Function of objective (dark blue) vs. subjective (orange) net gains from our Tax & Dividend.

Heterogeneity in bias In order to characterize profiles of individuals more likely to mis-perceive their gains, we regress mis-perception over many respondents' characteristics. Mis-perception is defined as a gap between objectively estimated and subjective net gains beyond 110€ per c.u., because our estimation differs from true objective gain by more than 110€ in only 5% of cases. This definition ensures that the 55% of respondents with a mis-perception have in fact a large bias. Other definitions for the bias yield very similar results. The results given in Table 3.1 show that mis-perception is largely idiosyncratic: controlling for a large set of variables[22] (column 1), the R^2 remains small (0.06). Still, we identify several variables having a significant effect on mis-perception even when controlling the False discovery rate at 5%.[23]. Environmentalists are about 6 p.p. less likely to display a large bias. Interestingly, while the standard left/right political leaning has no significant effect, the position towards the Yellow Vests appears to be the most critical determinant of mis-perception. Relative to respondents who declared to be opposed to the movement, those who declared to "under-

[22]The control variables used throughout the paper are described in Appendix F.

[23]To conduct the multiple testing procedure (following Benjamini & Hochberg, 1995), instead of associating each dummy to a different null hypothesis we used F-tests of joint nullity for the dummies of each categorical variables as well as for two additional triplets of variables: those related to household composition and incomes.

Table 3.1: Determinants of bias in subjective gains.

	Large bias ($\lvert\widehat{\gamma}-g\rvert > 110$)		
	OLS	*logistic*	*OLS*
Initial tax: PNR (I don't know)			−0.179
			(0.023)
Initial tax: Approves			−0.284
			(0.031)
Yellow Vests: PNR	0.039	0.035	0.024
	(0.036)	(0.035)	(0.036)
Yellow Vests: understands	0.081	0.062	0.041
	(0.025)	(0.024)	(0.025)
Yellow Vests: supports	0.108	0.103	0.051
	(0.026)	(0.025)	(0.026)
Yellow Vests: is part	0.202	0.193	0.147
	(0.048)	(0.040)	(0.047)
Ecologist	−0.064	−0.061	−0.025
	(0.026)	(0.026)	(0.026)
Left-right: Left	−0.066	−0.044	−0.045
	(0.063)	(0.065)	(0.061)
Left-right: Center	−0.062	−0.048	−0.046
	(0.065)	(0.068)	(0.064)
Left-right: Right	−0.024	−0.010	−0.026
	(0.064)	(0.066)	(0.063)
Left-right: Extreme-right	−0.076	−0.057	−0.088
	(0.066)	(0.069)	(0.065)
Left-right: Indeterminate	−0.009	0.017	−0.007
	(0.061)	(0.063)	(0.060)
Controls: Socio-demo, political leaning	✓	✓	✓
Observations	3,002	3,002	3,002
R^2	0.061		0.098

NOTE: Standard errors are reported in parentheses. For logit, average marginal effects are reported and not coefficients. Omitted variables are *Yellow Vests: opposes*; *Left-right: Extreme-left*. The list of controls can be found in Appendix F. A large bias is defined as a difference between subjective (g) and objectively estimated ($\hat{\gamma}$) net gain larger than 110€/year per c.u.

stand", "support", or "be part" of it are more likely to mis-perceive their gains. This effect is increasing with the degree of adhesion, up to 20 p.p. for individuals who declared to be part of the movement. Column (3) additionally includes one's position towards the policy as a covariate: we see that people who approve the policy are 28 p.p. less likely to mis-perceive their gains relative to those who do not accept it, and 10 p.p. less likely relative to those who do not know. We can think that the degree of support of the policy is what determines most of the bias (explaining e.g. why *Environmentalist* loses its explanatory power when we control for the support), and that the Yellow Vests variables remain significant only because they capture different *degrees* of rejection of the tax (which our Yes/No question cannot do).

Overall, typical biases are large and closely related to one's convictions. However, the direction(s) of causality between beliefs and rejection is not resolved at this stage. Section 4 provides evidence that some people think they lose because they oppose the tax, while Section 5 shows that perceived outcomes causally influence support.

3.2 Environmental effectiveness

A well established result in the literature on the acceptability of climate policies is the perceived ineffectiveness of Pigouvian instruments (e.g. Dresner et al., 2006a; Kallbekken et al., 2011; Baranzini & Carattini, 2017). In particular, people do not see carbon taxes as effective to fight climate change. Our findings confirm this result: among our survey respondents, only 17% answered "Yes" when asked whether our Tax & Dividend would be effective in reducing pollution and fighting climate change, 66% answered "No", 18% that they did not know.

An explanation sometimes encountered to explain perceptions of ineffectiveness is that most people believe that energy consumption is quite inelastic (Kallbekken & Sælen, 2011; Carattini et al., 2018). To test this hypothesis, we regress a binary variable E equal to 0 if the respondent does not perceive the policy as environmentally effective and 1 otherwise, on their subjective price elasticity for French people. As respondents were randomly assigned to transport or housing, we run a separate regression for both types of energies. Table D.1

in Appendix D.3 reports results with and without control variables. They all consistently indicate that perceived elasticities are correlated with beliefs about the policy's effectiveness, as a respondent anticipating an elasticity of -1 is (on average) 6 p.p. more likely to perceive the policy as effective than one anticipating no elasticity. Although significant, the magnitude of the effect is modest, showing that the perceived ineffectiveness of tax instruments should not be reduced to small subjective elasticities. Indeed, among respondents who perceive the policy as environmentally ineffective, almost half anticipate responses to price changes larger than the literature.[24]

A more plausible explanation for perceived ineffectiveness is that people do not believe that the policy would be sufficient to *substantially* affect pollution and climate change. Taking respondents' average anticipated elasticities for transport and housing energies (that are fairly accurate[24]), the tax should reduce French greenhouse gas (GhG) emissions by 5.7 Mt of CO_2 equivalent (CO_2e) each year, according to the simulation from BdF data. This reduction corresponds to 0.8% of French annual emissions, 0.01% of global ones, and is only a small step towards the official objective of carbon neutrality in 2050.[25] Thus, although respondents do anticipate responses to price incentives, our results suggest that they do not perceive a 50€/tCO_2 national carbon tax as a proportionate reaction to climate change.

3.3 Progressivity

It is often argued that a critical barrier to accept carbon taxation is its perceived distributional impact, in particular the higher burden imposed on lower income households (Bristow et al., 2010; Brannlund & Persson, 2012; Gevrek & Uyduranoglu, 2015). A broad literature has shown that carbon taxation alone is regressive (Poterba, 1991; Metcalf, 1999; Grainger

[24]Overall, average subjective elasticities are close to these estimates for transport (at -0.45) and somewhat overestimated for housing (-0.43). Among those who declared that the policy was not effective, 45% (resp. 43%) anticipated an aggregate elasticity at or below -0.5 for housing (resp. for transport), while elasticities obtained from the literature are around -0.2 for housing and -0.4 for transport.

[25]The computations are based on households' carbon emissions. In 2014, French GhG consumption based emissions were equal to 712 MtCO_2e (CGDD, 2019). 2017 global emissions were 53.5 GtCO_2e (UNEP, 2018).

& 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 — i.e. a Tax & Dividend — can make the policy progressive (West & Williams, 2004; Bento et al., 2009; Williams et al., 2015), including for France (Bureau, 2011; Douenne, 2020). Figure C.3 in Appendix C.4 displays the average net gain by income decile for our Tax & Dividend. It clearly appears from this figure that lower income households would gain more than richer households, both in relative and in absolute terms. Yet, only 19% of respondents think the policy would benefit the poorest households, compared to 60% who declare it would not, and 21% who do not know.

4 How attitudes shape beliefs

The previous section has shown that people's low acceptance of our Tax & Dividend correlates with pessimistic beliefs about the properties of the scheme. As knowledge about these properties has been shown to be decisive for acceptance (Carattini et al., 2018), it is important to assess how beliefs are formed. In the following, we test respondents' reactions to information about their gains, environmental effectiveness, and progressivity. If overly pessimistic views simply reflected a lack of knowledge, we would expect them to revise their beliefs after new information is provided, what we refer to as "update".

4.1 Self-interest

4.1.1 Pessimism in the revision of beliefs

Our respondent-specific estimation of net gains (see Section 2.3) enables us to tell respondents that given their characteristics, they have 5 out of 6 chances to "win" or "lose" from the policy. We can then examine how they update their beliefs about their win/lose category after receiving this information. The full transition matrices of people's beliefs are given in Tables D.2 and D.3 in Appendix D.2. More concisely, Table 4.1 reports the share of respondents whose beliefs after being informed are aligned with our feedback, with the corresponding

95% binomial confidence intervals. It shows a very asymmetric response depending on the feedback received. On the one hand, for the 24% of individuals who receive a "lose" feedback ($\widehat{\Gamma} = 0$), the *ex post* belief is on average consistent with the fact that 83% of them are effectively losers. If anything, these people would rather tend to *agree too much* with our noisy signal, especially when excluding people who initially consider themselves as unaffected (i.e. focusing on $g^0 \neq 0$). On the other hand, the 76% who received a "win" feedback ($\widehat{\Gamma} = 1$) appear to be much more conservative in their revision since only 25% of them endorse the "win" feedback. Among the respondents who initially thought they would lose in this group, a mere 12% flip their answer from "lose" to "win". This is in sharp contrast with the respondents who initially thought they would win and receive a "lose" feedback, since 82% of them endorse our prediction. Thus, pessimistic beliefs are persistent to our treatment, but optimistic ones are not.

Table 4.1: Share of respondents with new beliefs aligned with feedback.

	Aligned with feedback: $G^F = \widehat{\Gamma}$	
	Feedback:	
	win ($\widehat{\Gamma} = 1$) (75.8%)	lose ($\widehat{\Gamma} = 0$) (24.2%)
Initial belief winner ($g^0 > 0$) (14.0%)	78.8% [73.2%;83.4%]	81.5% [65.0%;91.3%]
Initial belief unaffected ($g^0 = 0$) (21.7%)	21.6% [17.6%;26.2%]	44.9% [33.5%;56.8%]
Initial belief loser ($g^0 < 0$) (64.3%)	12.2% [10.3%;14.5%]	93.9% [90.9%;96.0%]
Initial belief affected ($g^0 \neq 0$) (78.3%)	26.1% [23.7%;28.7%]	92.9% [89.8%;95.1%]
All (100%)	25.1% [23.0%;27.3%]	85.7% [82.2%;88.7%]

NOTE: The 95% confidence intervals for binomial probabilities are given in brackets. The Table reads as follows: among those who initially think they would win ($g^0 > 0$) but are told they are expected to lose ($\hat{\Gamma} = 0$), 81.5% agree that they would lose ($G^F = 0$). The feedback $\hat{\Gamma}$ is not a random draw, but a deterministic outcome of the characteristics reported by respondents in the survey.

Table D.4 in Appendix D.2 conducts the same analysis for the 28% of respondents whose gain is largely positive or largely negative, i.e. above 110€ per c.u. in absolute terms. For such respondents, our out-of-sample prediction of the win/lose category is correct in 99% of cases, as can be seen in the Figure D.1 in Appendix D.2. The alignments with our feedback are similar between the whole sample and these respondents for whom we are sure to make a correct prediction. The similarity of alignments for different prediction accuracy rules out the possibility that a large fraction of respondents do not update because their private information would be *truly* more accurate than our prediction.

4.1.2 Mechanisms

There are several ways to rationalize the pessimistic beliefs and attitudes against the Tax & Dividend. We propose below four mechanisms: distrust, uncertainty, motivated reasoning, and intentional mis-reporting.

Distrust The first mechanism is that respondents distrust what we present to them. They may perceive our information as biased, think we wrongly estimate their likelihood to win and that we are too optimistic.[26] As a result, they may discount our new information relative to their prior, or assign relatively more weight to our information when it is pessimistic. This distrust may stem from an impression that experts understate the costs of a carbon tax, or that the government will break its promise to pay the dividend. For instance, Sapienza & Zingales (2013) report that 51% of Americans are skeptical that their governments would deliver on using the proceeds of a carbon tax to reduce other taxes (see also Dresner et al., 2006a; Hsu et al., 2008). A similar level of skepticism regarding the dividend could explain much of the pessimism about net gains.

[26] Another possibility is that respondents give too much value to their private information relative to the base rate one. That is to say, pessimistic winners might be over-confident in seeing themselves as specific so that they partly discard the new information, e.g. by thinking they are part of the one-sixth for whom our prediction is erroneous, perhaps because they believe they always lose more than others from new policies.

Uncertainty The second mechanism stems from people's uncertainty regarding their gain. That uncertainty would make them see their possible gain as a distribution (see Stiglitz, 2019). Then, instead of reporting the average of this distribution, people subject to loss-aversion would reason with conservative estimates for their gains. Also, the effect of uncertainty on updating is ambiguous: on the one hand uncertain people could be more likely to rely on our base rate information, but on the other hand their subjective probability to lose could remain high despite our information.

Motivated reasoning The third mechanism to explain the observed asymmetry in beliefs revision is that some people have a strong skeptical attitude towards the carbon tax, which affects the formation of their beliefs. They would engage in motivated reasoning, i.e. update their beliefs in a way that is consistent with their initial views (Druckman & McGrath, 2019; Little, 2019) rather than integrate information in a way that leads to accurate conclusions. Although linked to the distrust in that motivated reasoning also involves neglecting information, in the case of distrust information is discarded because its source is not trusted, while for motivated reasoning information is dismissed when its content goes against pre-existing views. Motivated reasoning entails a deviation from Bayesian updating — contrary to the first two mechanisms —, but it can still be *rationalized* as a psychological adaptation to preserve one's sense of identity (Kahan, 2013). We make a case for motivated reasoning in Section 4.1.4.

Intentional mis-reporting A fourth possibility is that some respondents intentionally report overly pessimistic beliefs compared to what they actually think. This could stem from a rejection of the tax and could follow from strategic thinking if they believe their survey answers might influence policy-makers. Such respondents could be aware that they would gain but still reject the tax for other motives, even more so if they are still uncertain about their gain. Their mis-reporting could also be due to a type of motivated reasoning that would not directly affect their beliefs, but rather induce them to mis-report what they think. This could help them justify their rejection of the policy, even more so that it could be costly for

their ego to admit they were wrong to reject the policy.

4.1.3 Heterogeneity in pessimism

In order to know more about the determinants of the above pessimism, we investigate the heterogeneity in updating. 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, 0 if they do not update, or -1 if they initially felt *unaffected* but update against the feedback. Over the sub-sample of *invalidated* respondents who should have updated because their initial win/lose category is not aligned with our feedback ($g_i \cdot \widehat{\gamma}_i \leq 0$), we regress the *correct updating*, U, over the initial belief not to lose, G^0, and a vector of characteristics, $\mathbf{C}$:

$$U_i = \delta_0 + \beta_U G_i^0 + \beta_{\mathbf{C}} \mathbf{C} + \varepsilon_i \quad \text{for } i : \; g_i \cdot \widehat{\gamma}_i \leq 0, \tag{3}$$

The high values for β_U reported in columns (1-3) of Table 4.2 again prove that, among those who should have updated, those who initially think they would win (the optimistic losers) update significantly more correctly than those who do not think so (the pessimistic winners). Beyond this asymmetry, columns (2-5) show that some respondents' characteristics are correlated with correct updating. Relative to unemployed and inactive people, retired, active, and students update more correctly, the latter being 22 p.p. more likely to correctly revise their beliefs when invalidated than unemployed and inactive (column 2). The categories of respondents who initially displayed the largest bias also appear to update less correctly. Indeed, people who are part of the Yellow Vests movement are 14 p.p. less likely to correctly update than people who oppose it, even when controlling for disapproval of the policy which itself decreases the likelihood to correctly update by 18 p.p. The previous characteristics could be correlated to people's uncertainty. Alternatively, the Yellow Vests' higher distrust of the government (documented in Algan et al., 2019) could also apply to information provided by researchers regarding policies. Finally, these results also indicate that motivated reasoning may be at play.

Table 4.2: Heterogeneity in updating.

	Correct updating (U)				
	(1)	(2)	(3)	(4)	(5)
Constant	0.120	−0.036	−0.011	−0.073	0.707
	(0.012)	(0.190)	(0.192)	(0.192)	(1.007)
Winner, before feedback ($\dot{G}$)	0.695	0.551	0.563		
	(0.078)	(0.083)	(0.083)		
Initial tax: PNR (I don't know)		0.179	0.186	0.199	0.113
		(0.032)	(0.067)	(0.033)	(0.155)
Initial tax: Approves		0.176	−0.031	0.216	−0.162
		(0.046)	(0.115)	(0.049)	(0.185)
Diploma × Initial tax: PNR			−0.003		
			(0.025)		
Diploma × Initial tax: Approves			0.072		
			(0.037)		
Subjective gain (g)		0.0004	0.0004	0.001	−0.001
		(0.0002)	(0.0002)	(0.0003)	(0.004)
Subjective gain: unaffected ($g = 0$)		−0.127	−0.126	−0.208	−0.331
		(0.033)	(0.033)	(0.033)	(0.219)
Bias about gain ($g - \hat{\gamma}$)		−0.00005	−0.0001	−0.001	−0.0003
		(0.0001)	(0.0001)	(0.0003)	(0.0002)
Diploma (1 to 4)		0.014	0.009	−0.001	0.148
		(0.013)	(0.014)	(0.013)	(0.078)
Retired		0.130	0.127	0.108	0.124
		(0.079)	(0.079)	(0.080)	(0.435)
Active		0.166	0.165	0.160	0.113
		(0.054)	(0.054)	(0.054)	(0.365)
Student		0.224	0.229	0.183	0.402
		(0.075)	(0.075)	(0.074)	(0.526)
Yellow Vests: PNR		−0.045	−0.047	−0.031	0.013
		(0.047)	(0.047)	(0.048)	(0.246)
Yellow Vests: understands		−0.065	−0.066	−0.059	0.141
		(0.034)	(0.034)	(0.034)	(0.170)
Yellow Vests: supports		−0.063	−0.063	−0.050	−0.156
		(0.036)	(0.036)	(0.036)	(0.206)
Yellow Vests: is part		−0.141	−0.142	−0.106	−0.985
		(0.061)	(0.061)	(0.063)	(0.367)
Includes "pessimistic winners"	✓	✓	✓	✓	
Includes "optimistic losers"	✓	✓	✓		✓
Controls: socio-demo, politics, estimated gains		✓	✓	✓	✓
Observations	1,365	1,365	1,365	1,265	100
R^2	0.055	0.144	0.146	0.115	0.696

NOTE: Omitted variables are *Unemployed/Inactive* and *Yellow Vests: opposes*. The list of controls can be found in Appendix F.

4.1.4 Motivated reasoning

The previous results suggest that conservatism in beliefs' revision does not simply follow from people's cognitive difficulties when dealing with Bayes' rule. The higher likelihood to update correctly of those who support the reform is robust evidence that political views and identity shape beliefs' formation. Indeed, the more people oppose the tax, the less likely they are to correctly update, as shown in columns (2-5) of Table 4.2. From columns (4-5) we also see that this result is entirely driven by the "pessimistic winners": the updating of people who wrongly think they win does not depend on their approval, another indication that the revision in beliefs is driven by a rejection of the tax. This is not to say that few people seek to reach accurate beliefs. It could still be the case that informing any respondent that they would win makes them revise their subjective gain by, say, 100€ upwards, leading only those with small subjective losses to discover that they would win. One can actually see from the positive and statistically significant effect of *subjective gain (g)* that such an accuracy motive is at play. However, this effect remains small relative to those indicative of policy support, pointing out the importance of motivated reasoning. Column (3) further shows that the effect of approving the policy on correct updating is even stronger for more educated people — as the interaction term between approval and diploma is positive and significant —, even capturing all the effect of initial tax approval.

The previous findings are comparable to empirical evidence from Kahan (2013) that political motivated reasoning about climate change is not a reasoning deficiency but rather a reasoning adaptation following the interest that individuals have in conveying "their membership in and loyalty to affinity groups central to their personal well-being". In our case, the position relative to the Yellow Vests proxies the groups that respondents identify with, and the differentiated updating along this spectrum can be interpreted as motivated reasoning. Besides, the hypothesis that motivated reasoning follows from a rational adaptation purpose can explain our finding that better educated people are *more* prone to motivated reasoning, as they are more able to formulate specious reasonings and reconcile antagonistic information and ideas. To our knowledge, this result is the first evidence of rational motivated reason-

ing in the context of climate policies, complementing the findings of Druckman & McGrath (2019) that this mechanism can explain polarization around beliefs on climate change.[27]

Building upon the cognitive and social mechanisms described by Kraft et al. (2015) and documented by e.g. Redlawsk (2002), we hypothesize the following narrative as one of the possible channels through which aversion for the carbon tax became entrenched. The Yellow Vests first gathered to defend their interest (above all their purchasing power), and a side effect of the daily interactions on roundabouts was to bring material and emotional support to the protesters (Challier, 2019). A group identity soon developed, which crystallized shared beliefs and affects such as a rejection of carbon taxation. This group identity gained support from a large majority of the population, notably through social networks. Now, due to the loyalty to the group as well as the affects that have entered their subconscious, Yellow Vests supporters oppose instinctively any carbon tax, and are prone to find excuses to cope with contradictory messages, e.g. by denying the reliability of these messages (Golman et al., 2016). Admittedly, such a narrative falls short of explaining the majority rejection among those who oppose the Yellow Vests (which may originate from pessimistic perceptions more than tax aversion), but it illustrates how pessimistic beliefs can be so persistent among Yellow Vests supporters.

Overall, these results show that people's pessimistic beliefs about the incidence of a Tax & Dividend are very persistent. This pessimism is consistent with people forming their beliefs in a motivated way. Still, other mechanisms — such as a distrust of the government — may play a key role. Further research with a different design would be needed to conclude about the relative importance of these different mechanisms.

[27] This evidence provides empirical support for various models of endogenous belief formation. For example, Little (2019) formalizes the idea that directional motives may override accuracy motives and people update auxiliary beliefs (in our case, the win/lose category) in order to preserve their consistency with core beliefs (here, rejection of the tax). Admittedly, one might expect the importance of accuracy motives relative to directional motivated reasoning to increase in a higher stakes environment. However, this hypothesis cannot be tested in our set-up, and previous literature does not provide conclusive evidence on the matter (Kunda, 1990; Camerer & Hogarth, 1999).

4.2 Environmental effectiveness

Table D.5 in Appendix D.3 reports the effect of displaying relevant information on the belief that our Tax & Dividend is environmentally effective. The effect of reporting a scientific consensus on environmental effectiveness (E) is positive and statistically significant, but its magnitude — around 5 p.p. — seems modest given that the question immediately follows the priming. The effects of information on climate change (CC) or particulates (PM) are smaller, and only CC is significant, which is understandable as they were displayed at the very beginning of the survey and do not mention any environmental policy. As suggested by Millner & Ollivier (2016), given the complexity of the mechanisms at play, drawing a causal link between causes and consequences of environmental problems requires considerable cognitive effort, making it difficult to convince one about the effectiveness of policies that decentralize efforts to tackle pollution. Finally, we observe that our primings have no significant effect on beliefs over causes and consequences of climate change. Overall, these primings appear insufficient to change most people's mind about climate change and carbon tax effectiveness.

4.3 Progressivity

Table D.6 in Appendix D.4 shows the absence of effect of explaining that our Tax & Dividend is progressive on perceived progressivity: the correlation between the two is close to 0 (at -0.006) and even has an unexpected negative sign. Column (2) of the same table clarifies why our treatment does not change the overall share of people who think the policy is regressive: those who have a large bias in their perception of gains are in fact *more* prone to perceive *regressivity* once provided the information, by 13 p.p. This result may be a manifestation of the boomerang effect with people inclined to motivated reasoning, which has already been documented for Republican attitudes over climate change in the US (Zhou, 2016). Indeed, Hovland et al. (1953) showed that when someone is pressured to make a certain choice, psychological reactance (theorized by Brehm, 1966) can cause them to resist this pressure by adopting an opposite alternative. Although the effect on those without

a large bias is not significant, providing them with information is associated with a lower perceived regressivity by 5 p.p. A possible explanation for the strong belief in regressivity is that people view the tax as regressive (relative to income) and the transfer as neutral (in absolute values), and mistakenly conclude that their combination is regressive. In any case, without a deep explanation of the underlying mechanisms, the progressivity of the policy remains unintuitive for most people, and we cannot convince them easily.

5 How beliefs determine attitudes

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 display overly pessimistic 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 intrinsic preferences or wrong perceptions. The question we address is whether convincing people about the actual incidence of the policy and its effectiveness would be sufficient to generate public support.

5.1 Self-interest

Identification challenge Among the three-quarters of the respondents expected to win from our Tax & Dividend, 62% both consider that they would not win and disapprove of the policy. We want to estimate to what extent knowing they would win would lead them to approve of 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 & Targeted Dividend, where respondents are randomly assigned to a compensation

scheme to which they are eligible or not depending on their income (see Section 2.2.2). Formally, we denote by $I_{i,1}$ the income percentile of respondent's i, and by $I_{i,2}$ that of the second adult of their household if there is one. We define eligibility of adult $j \in \{1;2\}$ as:[28]

$$T_{i,j} = \begin{cases} 0, & \text{if } I_{i,j} > t_i \\ 1, & \text{otherwise} \end{cases} \tag{4}$$

where $t_i \in \mathscr{T} = \{20;30;40;50\}$ is the eligibility threshold randomly allocated to household i (see Section 2.2.2). As eligibility increases the likelihood — but does not necessarily implies — to believe that one wins from the policy, our method leads to a fuzzy regression discontinuity design (RDD), where the eligibility corresponds to the intention to treat and the respondents who believe they win correspond to the treated. Formally, we denote by G_i^T a dummy variable equal to 0 if respondent i thinks they would lose from the Tax & Targeted Dividend, and 1 otherwise. Similarly, A_i^T is a dummy variable equal to 0 if respondent i disapproves of this policy and 1 otherwise. We can then write the model as a two-stage least square, with the following first stage equation:

$$G_i^T = \alpha_0 + \alpha_{T,1} T_{i,1} + \alpha_{T,2} T_{i,2} + \alpha_{T,3} \left(T_{i,1} \times T_{i,2}\right) + \sum_{k \in \mathscr{T}} \alpha_k \mathbb{1}_{t_i=k} + \alpha_S S_i + \alpha_{\mathbf{C}} \mathbf{C_i} + \alpha_{\mathbf{I}} \mathbf{I_i} + \eta_i \tag{5}$$

where $\mathbf{C_i}$ is a vector of respondents' characteristics, S_i a dummy variable equal to 1 when there is a single adult in the household, and $\mathbf{I_i}$ a vector of income variables defined as $\left(I_{i,j}, \left(\min(I_{i,j} - k, 0)\right)_{k=20,70}\right)'_{j=1,2}$. $\mathbf{I_i}$ allows for a continuous piecewise linear relationship in incomes with slope changes at the 20th and 70th percentiles. Fixed effects for the policy assigned $\mathbb{1}_{t_i=k}$ ($k \in \mathscr{T}$) are also introduced to control for preferences regarding the specificities of the policy, i.e. the share of the population targeted by the policy and the value of the dividend. Finally, the second stage writes:

$$A_i^T = \beta_0 + \beta_1 \widehat{G}_i^T + \sum_{k \in \mathscr{T}} \beta_k \mathbb{1}_{t_i=k} + \beta_S S_i + \beta_{\mathbf{C}} \mathbf{C_i} + \beta_{\mathbf{I}} \mathbf{I_i} + \varepsilon_i \tag{6}$$

[28] As explained in Section 2.2.2, we explicitly limit the number of beneficiaries to two per household.

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 E.1, eligibility of both respondents and households' second adults are positively correlated with beliefs of winning, so both instruments are relevant. The exclusion restriction states 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, eligibility is random, and controlling for the specific policy assigned ($\mathbb{1}_{t_i=k}$), it should affect acceptance only through self-interest.

Alternative specifications for robustness To get more precise estimates, we include control variables in all specifications. In particular, we control for initial acceptance of our Tax & Dividend as this should explain much of the variation in the dependent variable. In our main specification (1), we also exclude households where none of the adults has an income lying between the 10th and 60th percentiles, to keep only those close enough to the thresholds. In specification (2) we replicate the same estimation on the full sample. In (3), we also compare our results with a simple OLS regression on the full sample. Finally, in (4) we exploit a methodology similar to the main specification — i.e. a fuzzy RDD — but applied to the customized feedback. Indeed, we use our estimation of respondents' net gains $\widehat{\gamma}$ as the assignment variable, and the binary win/lose feedback $\widehat{\Gamma}$ as the intention to treat. As our feedback $\widehat{\Gamma}$ (which goes from 0 to 1 at the threshold of zero net gain) is predictive of the belief about the win/lose category after feedback, G^F, we can determine the effect of this belief on acceptance, A^F. This alternative fuzzy RDD leads to the following two-stage least square:

$$G_i^F = \alpha_0 + \alpha_1 \widehat{\Gamma}_i + \alpha_{\gamma,1}\widehat{\gamma}_i + \alpha_{\gamma,2}\widehat{\gamma}_i^2 + \alpha_{\mathbf{C}}\mathbf{C_i} + \alpha_{\mathbf{I}}\mathbf{I_i} + \eta_i \tag{7}$$

$$A_i^F = \beta_0 + \beta_1 \widehat{G}_i^F + \beta_{\gamma,1}\widehat{\gamma}_i + \beta_{\gamma,2}\widehat{\gamma}_i^2 + \beta_{\mathbf{C}}\mathbf{C_i} + \beta_{\mathbf{I}}\mathbf{I_i} + \varepsilon_i \tag{8}$$

where $\widehat{G}_i^F$ denotes the fitted value of G_i^F from the first stage regression. The identification assumption of this second IV states that conditional on estimated net gains ($\widehat{\gamma}$) — that we con-

trol for with a quadratic specification — receiving a win feedback ($\widehat{\Gamma} = 1$) affects approval solely through self-interest. We again restrict our analysis to respondents close enough to the threshold by keeping only those with net gains below 50€ per annum in absolute value ($|\widehat{\gamma}| < 50$).

Finally, we investigate alternative versions of the previous models in Appendix E.2. We estimate the effect to "win" instead of "not to lose", and on "approval" instead of "acceptance", and we compare the OLS with a logit model to ensure that imposing linearity does not bias the results (Table E.3). We estimate our main specification with the slope in incomes changing at an additional thresholds (30th, 40th, 50th or 60th percentile). Finally, we allow for heterogeneous effects along the income dimension (Table E.4).

Table 5.1: Effect of self-interest on acceptance

	Acceptance ("Yes" or "Don't know" to policy support)			
	Targeted Dividend (A^T)			After Feedback (A^F)
	IV: random target/eligibility		*OLS*	*IV: discontinuity in feedback*
	(1)	(2)	(3)	(4)
Believes does not lose (G)	0.534	0.476	0.438	0.644
	(0.132)	(0.106)	(0.014)	(0.170)
Initial tax Acceptance (A^0)	0.356	0.354	0.361	0.420
	(0.041)	(0.034)	(0.026)	(0.074)
Controls: Incomes (piecewise continuous) estimated gains, socio-demo, other motives	✓	✓	✓	✓
Controls: Policy assigned	✓	✓	✓	
Sub-sample	[p10; p60]			$\|\widehat{\gamma}\| < 50$
Effective F-Statistic	15.6	23.8		21.3
Observations	1,969	3,002	3,002	757
R^2	0.320	0.308	0.472	0.541

NOTE: Standard errors are reported in parentheses. The list of controls can be found in Appendix F. The source of exogenous variation in the belief used in first-stages for the targeted dividend is the random assignment of the income threshold, which determines eligibility to the dividend. The first-stage for the non-targeted dividend exploits instead the discontinuity in the win/lose feedback when the net gain switches from negative to positive.

Results First stage regression results are given in Appendix E.1. The effective F-Statistics (Olea & Pflueger, 2013) range from 15.6 to 23.8, indicating that both targeted transfers and feedback are strong instruments. Table 5.1 provides the second stage results for the six main specifications, and additional specifications can be found in Appendix E.2. Overall, the estimated effects of self-interest indicate that believing not to lose increases acceptance by about 50 p.p. Both IV strategies yield consistent results, although they apply to different policies since the revenue-recycling is not designed in the same manner. The different results between the two local average treatment effects (LATE) (53 p.p. in column (1) vs. 64 p.p. in (4)) could also be due to the specificity of compliers in each setting. Since we have shown in Section 4.1 that respondents most likely to revise their beliefs after a "win" feedback are less opposed to the tax, they may also be more inclined to accept the policy once they are convinced that they win. Those most likely to comply in this setting could thus be more specific than those who comply when they are provided a (targeted) dividend that is large enough. The specificity of compliers could also explain why the average treatment effect estimated with the OLS is somewhat lower (44 p.p. in (3)), although the difference may also be due to a bias in the OLS that would remain despite our powerful controls. The result of the OLS is also very close to the one obtained from our main IV on the full sample (48 p.p. in (2)). The lower estimate found compared to (1) could again be due to heterogeneous preferences between respondents depending on their income — with people at the bottom and top of the income distribution less likely to revise their support when they learn that they win — or from a less accurate identification when we enlarge the window and compare less similar respondents. Column (1) of Table E.4 in appendix confirms the existence of heterogeneous effects along the income distribution. Indeed, we find a larger effect for lower incomes, which may be due heterogeneous preferences or to the higher intensity of the treatment for low-income people (whose dividend represents a higher income share than average).

Overall, these results show that convincing citizens' of the true incidence of a Tax & Dividend could largely increase the support for such policy. Our results also qualify the findings of Anderson et al. (2019) who suggest that ideology better predicts carbon tax acceptance

than self-interest. By distinguishing beliefs from preferences, we find that ideology plays an indirect role by shaping beliefs about one's self-interest, and that beliefs directly affect acceptance.

5.2 Environmental effectiveness

Main identification strategy One of the strongest barriers to carbon tax implementation is a widespread perception of its environmental ineffectiveness. Our objective is therefore to assess to what extent learning about the environmental benefits of the tax could increase support. To identify this effect, we estimate a two-stage least squares (2SLS) where the first stage uses random information to predict beliefs about environmental effectiveness, while the second stage regresses acceptance on the fitted exogenous variations in these beliefs. Because information on particulate matter (Z_{PM}) is poorly correlated with beliefs of effectiveness, we restrict the set of instruments to our primings on the scientific consensus (Z_E) and climate change (Z_{CC}). Even though these primings do not have a very large effect on people's beliefs (as discussed in Section 4.2), these instruments are significantly related to our endogenous variable. Denoting by $\dot{A^0}$ the dummy for an initial approval of the Tax & Dividend and $\dot{E}$ the dummy for the belief that the policy is environmentally effective, we can write a 2SLS model as follows:

$$\dot{E}_i = \alpha_0 + \alpha_1 Z_{E,i} + \alpha_2 Z_{CC,i} + \alpha_{\mathbf{C}} \mathbf{C_i} + \eta_i \tag{9}$$

$$\dot{A_i^0} = \beta_0 + \beta_1 \widehat{\dot{E}_i} + \beta_{\mathbf{C}} \mathbf{C_i} + \varepsilon_i \tag{10}$$

where $\widehat{\dot{E}_i}$ denotes the fitted value of $\dot{E}_i$ from the first stage regression, and $\mathbf{C}$ a vector of characteristics.

Alternative specifications for robustness checks Acknowledging that our primings could affect acceptation motives other than effectiveness alone, we include other motives in our list of control variables to avoid a potential bias. In addition to the 2SLS (specification 1), we

estimate an OLS (2) model to compare the LATE of our main specification with an ATE. For these two first specifications, we adopt strict definitions for our variables (i.e. answer "Yes", denoted by a dot, to the belief in effectiveness and approval). Indeed, our instruments appear more effective to switch answers from "PNR" to "Yes" than from "No" to "PNR", hence a larger statistical power with strict definitions. Specification (3) takes acceptance instead of approval as the dependent variable. In appendix, we also estimate a 2SLS with broad definitions only (i.e. effect of a *not "No"* belief at effectiveness on acceptance of the policy), as well as two OLS regression ("Yes" on acceptance and *not "No"* on acceptance), and a logit model to check the robustness of the linearity assumption of our specification (2). As a robustness check, we also report results of a limited information maximum likelihood (LIML) estimation of our main results in Appendix (Table E.5).

Table 5.2: Effect of believing in environmental effectiveness on approval

	Initial Tax & Dividend		
	Approval ($\dot{A}^0$)		Acceptance (A^0)
	IV	*OLS*	*IV*
	(1)	(2)	(3)
Believes in effectiveness ($\dot{E}$)	0.416	0.374	0.505
	(0.168)	(0.013)	(0.242)
Instruments: info E.E. & C.C.	✓		✓
Controls: Socio-demo, other motives, incomes, estimated gains	✓	✓	✓
Effective F-Statistic	11.2		11.2
Observations	3,002	3,002	3,002
R^2	0.161	0.342	0.218

NOTE: Standard errors are reported in parentheses. The list of controls can be found in Appendix F, and first stage results in Table E.2 on page 63. The dependent variable corresponds to either initial approval (answer "Yes" to support of the policy) or acceptance (answer not "No"). The first stage exploits the information randomly displayed about climate change (C.C.) and the effectiveness of carbon taxation (E.E.) as exogenous instruments.

Results The first stage regressions results can be found in Appendix E.1. Because of the relatively modest responses to our primings, the instruments are rather weak when broad definitions (i.e. *not "No"*) are taken in the first stage (effective F-statistic of 6), a problem that is alleviated in the case of strict definitions (11 in column 1 and 3). Given the exogeneity of our instruments, the only concern is a potential bias towards OLS, which — as suggested by the results of column (2) — would entail estimates that are too conservative in our case. Table 5.2 reports the results of the second stages. They all consistently indicate a strong positive and significant effect of beliefs about environmental effectiveness on support for the policy. All else equal, believing that the tax is effective increases the likelihood to accept it by 51 p.p. (3), and to approve it by 42 p.p. (1). The LATE is only slightly higher than the ATE estimated with OLS (2) — 42 vs. 38 p.p. The lower results obtained with OLS are more pronounced when using broad definitions for our variables, as can be seen in appendix (Table E.5). This discrepancy may be due to a bias in the OLS, or to the specificity of compliers: people who are most likely to change their mind following our information might also be more willing to accept the policy. Finally, we obtain identical results when running a 2SLS or a LIML for our main specification (1). For the strict definition of effectiveness, the LIML estimate (A2) is broadly consistent with the 2SLS (3), though somewhat higher (64 p.p. vs. 51 p.p.).

5.3 Progressivity

As informing respondents does not convince them that our Tax & Dividend is progressive (see Section 4.3), we cannot perform an IV estimation to identify the causal effect of understanding the progressivity on support for the policy. In our online Appendix J, we estimate how one's belief in progressivity — interacted with other motives — correlates with acceptance using simple OLS and logit regressions. Controlling for many respondents' characteristics and other motives of support, the effect of progressivity remains statistically significant, and as high as 27 p.p. in our preferred specification. Of course, this result should be taken with caution since we can still suspect the results to be affected by unobserved confounders

and reverse causality.

6 Conclusion

In this paper, we study how beliefs about a policy form and then determine attitudes towards it. We investigate this question through the study of carbon taxation in France during the Yellow Vests movement, that started against fuel price increases. Our analysis is based on a new survey and official household survey data, enabling one to compare subjective beliefs with objective impacts on French households. We find that 70% disapprove of a carbon Tax & Dividend policy, which can be explained by pessimistic beliefs about its properties. 89% of our survey respondents overestimate its negative impact on their purchasing power, and most of them do not perceive it as environmentally effective, nor progressive. Pessimistic beliefs appear correlated with people's support for the scheme: the more they oppose the mechanism, the more pessimistic they are. Our results support a bi-directional causality between beliefs and attitude towards the policy. People more opposed to the tax are more (pessimistically) biased in their treatment of *new* information with respect to it, indicating that beliefs about tax impacts are shaped by political identity. At the same time, we find that acceptance is causally determined by beliefs and that if people could be convinced about the incidence and effectiveness of a Tax & Dividend, this policy would likely be accepted by a majority, given the large effects of these motives (about 50 p.p. each).

However, our treatments that provide accurate arguments in favor of the scheme mostly fail to convince people. The pessimism could be related to a strong distrust of the government, documented e.g. in Alesina et al. (2018) and Algan et al. (2019), echoing recent findings that the ambition of climate policies increases with the level of trust (Rafaty, 2018). These results leave us with three main challenges. First, as it is unlikely that the issue of trust can be resolved in the short run, it seems necessary to find climate policies that would be accepted by a majority. We address this question in a companion paper (Douenne & Fabre, 2020), in which we assess both knowledge and beliefs about climate change, and the preferred policies of French people. Second, as trust in government needs to be restored in

the longer run, it is crucial to analyze what causes the distrust and how it can be overcome. Third, it is important to assess to what extent the mechanisms of belief formation and their effects on political attitudes we document can be generalized to other policies and other contexts. Although rejection of the tax may be lower in a different country, biases in perceptions and political polarization may happen everywhere. Thus, a lesson must be learned for policy design and implementation, to avoid another carbon tax debacle *à la Française*.

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Appendices

A Raw data

Table A.1: Sample characteristics: quotas.

	Population	Sample
Sex		
woman	*0.52*	0.53
man	*0.48*	0.47
Age		
18-24	*0.12*	0.11
25-34	*0.15*	0.11
35-49	*0.24*	0.24
50-64	*0.24*	0.26
>65	*0.25*	0.27
Profession		
farmer	*0.01*	0.01
independent	*0.03*	0.04
executive	*0.09*	0.09
intermediate	*0.14*	0.14
employee	*0.15*	0.16
worker	*0.12*	0.13
retired	*0.33*	0.33
inactive	*0.12*	0.11
Education		
No diploma or *Brevet*	*0.30*	0.24
CAP or *BEP*	*0.25*	0.26
Bac	*0.17*	0.18
Higher	*0.29*	0.31
Size of town		
rural	*0.22*	0.24
<20k	*0.17*	0.18
20-99k	*0.14*	0.13
>100k	*0.31*	0.29
Paris area	*0.16*	0.15
Region		
IDF	*0.19*	0.17
Nord	*0.09*	0.10
Est	*0.13*	0.12
SO	*0.09*	0.09
Centre	*0.10*	0.12
Ouest	*0.10*	0.10
Occ	*0.09*	0.08
ARA	*0.12*	0.13
PACA	*0.09*	0.08

Table A.2: Households' characteristics.

	Population	Sample
Household composition (mean)		
Household size	*2.36*	2.38
Number of adults	*2.03*	1.93
c.u.	*1.60*	1.61
Energy source (share)		
Gas	*0.42*	0.36
Fuel	*0.12*	0.09
Size of accommodation (m^2)		
mean	*97*	96
p25	*69*	66
p50	*90*	90
p75	*120*	115
Distance travelled by car (km/year)		
mean	*13,735*	15,328
p25	*4,000*	4,000
p50	*10,899*	10,000
p75	*20,000*	20,000
Fuel economy (L/100 km)		
mean	*6.39*	7.18
p25	*6*	5
p50	*6.5*	6
p75	*7.5*	7

SOURCES: Matched BdF; except for number of adults (ERFS) and domestic fuel (CEREN).

NOTE: After controlling the False discovery rate at 5%, *t*-tests reject that the sample mean is equal to the population mean for 12 of our 42 variables in Tables A.1 and A.2. Back to Section 2.2.2 on page 9.

B Notations

To improve the understanding of our specifications in the regression Tables, we adopt consistent notations throughout the paper. For questions where possible answers are "Yes"/"No"/"PNR", we define two kinds of dummy variables: the default ones correspond to *not "No"* answers, while we put a dot on dummy variables for *"Yes"*. For example, acceptance is denoted A while approval is denoted $\dot{A}$. Furthermore, for questions that are asked several times, namely acceptance and win/lose category, an exponent is added to specify the step at which the question is asked. Table B.1 describes these exponents as well as the notations corresponding to the different notions of gain that we use. Uppercase is used for binary and lowercase for continuous variables, Greek letters denote objective notions, with a hat for our estimation of gains and without for the true (unknown) ones. To give another example, the broad notion of self-interest at the initial step, i.e. the belief that one does not lose, is denoted G^0, and the strict belief that one wins at Tax & Targeted dividend is denoted $\dot{G}^T$.

Table B.1: Notations for the different reforms and for gain notions.

Step	Initial	after information: 1		with Targeting
Variants	–	Progressivity	Feedback	–
Exponent	0	P	F	T

Gain	Subjective	True	Estimated
Numeric	g	γ	$\widehat{\gamma}$
Binary	$\dot{G}\,(g>0)$, $G\,(g\geq 0)$	Γ	$\widehat{\Gamma}$

NOTE: Back to Section 2.3 on page 15.

C The use of official household survey data

The paper makes use of official survey data for two purposes: (*i*) computing the distribution of increases in fossil fuels expenditures, (*ii*) predicting the expected net gain of each respondent based on their energy characteristics. Section C.1 presents the three official sur-

veys from Insee (the French national statistics bureau) that are used. Section C.2 details the formulas needed to compute the value of the dividend and households' expected net gains from their expenditures. Section C.3 explains how using two distinct survey we can obtain a simple formula to predict respondents' net gain simply based on their energy characteristics and then test out-of-sample the likelihood to make a correct prediction. Finally, Section C.4 displays the objective net gain of the policy by income decile to show that it is progressive.

C.1 Official households surveys from Insee

Consumer survey "Budget de Famille" The consumer survey (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 transportation energies are reported. Consumption of housing energies is taken from households' bills, and for most other goods respondents report their expenditures over the past week. However, as explained in Douenne (2020), this data collection is problematic when looking at the incidence of a tax on transportation energies, as short-run fluctuations in consumption lead to overestimate the heterogeneity in expenditures.

Transport survey "Enquête Nationale Transports et Déplacements" To overcome this limitation, BdF is matched with the transport survey (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 use over the past week, but most importantly it gives information on annual distances travelled with these vehicles. This last information enables us to recover the distribution of transport fuel expenditures without over-estimating its spread. Such matching is not necessary for housing energies as these already represent consumption over long periods in BdF.

Housing survey "Enquête Logement" The housing survey (EL 2013) was conducted between June 2013 and June 2014 over a sample of 27,137 households in metropolitan France. It includes many information on households' characteristics, as well as their housing energy bills. The distribution of energy expenditures is very close to that of BdF.

C.2 Formulas to compute monetary effects of carbon tax policy

In order to compute the monetary impact of a carbon tax increase on a household h, we decompose current energy expenditures $E_h(\tau)$ as a product of current price $P(\tau)$ and current quantities consumed $Q_h(\tau)$, each being a function of the excise tax τ within which the carbon tax is comprised:[29]

$$E_h(\tau) = P(\tau) Q_h(\tau)$$

Small variations in expenditures can then be expressed as:

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

The variation in quantities can be rewritten as a function of the price variation:

$$\frac{dQ}{Q}(\tau) = e\frac{dP}{P}(\tau)$$

where $e = \frac{dQ_h}{dP} \cdot \frac{P}{Q_h}$ is the price elasticity of the energetic good considered, that is assumed constant and identical across households. 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 (assumed constant) that applies after excise taxes, i the incidence of excise taxes on consumers (assumed constant), and $p + (i-1)\tau$ the producer price as a function of τ.[30] When the carbon price changes so that the excise taxes varies from τ to some level τ', we therefore have:

[29] 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.

[30] Hence p is the producer price when $\tau = 0$.

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

Thus, carrying on the first-order approximation, one can express increase in expenditures associated with a carbon price increase as:

$$\Delta E_h(\tau) = E_h(\tau)(1+e)\frac{\Delta P}{P} = E_h(\tau)(1+e)\frac{i(\tau' - \tau)}{p+i\tau} \tag{11}$$

We can replicate similar calculations to obtain the expected variations in tax paid on energies by household h, ΔT_h. Starting from the expression of T_h — which is the sum of excise taxes and the VAT over the energy good — we have:

$$T_h(\tau) = Q_h(\tau)\left((1+t)\tau + t\big(p + (i-1)\tau\big)\right)$$

from which we obtain:

$$\Delta T_h(\tau) = Q_h(\tau)\left(1 + e\frac{i(\tau' - \tau)}{p+i\tau}\right)\left(t\big(p+(i-1)\tau'\big) + (1+t)\tau'\right) - Q(\tau)\left(t\big(p+(i-1)\tau\big) + (1+t)\tau\right) \tag{12}$$

Finally, the net gain of an household h from a Tax & Dividend writes:

$$\gamma_h(\tau) = N_h^a \cdot \frac{\sum_h \Delta T_h(\tau)}{N^a} - \Delta E_h^{transport}(\tau) - \Delta E_h^{housing}(\tau) \tag{13}$$

where γ_h denotes its net gain from the policy, N_h^a the number of adults receiving the dividend in this household, N^a the total number of adults receiving it, and $\Delta E_h^{transport}$ (resp. $\Delta E_h^{housing}$) the increase in their expenditures in transport (resp. housing) energies. From households' energy expenditures, and making assumptions on elasticities and tax incidence, equations (11) to (13) enable us to obtain the value of dividend and the impact of the policy on households' purchasing power. We use equation (13) to estimate the biases and objective distribution of net gains in Section 3, as well as the customized feedback in Section 4.

When asked to estimate the impact of the policy on their own purchasing power, respondents simply had to make an estimation over:

$$\Delta E_h(\tau) = E_h(\tau)(1+e)\frac{\Delta P}{P}$$

where for simplicity ΔP was given for transport fuels, and $\frac{\Delta P}{P}$ 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.

C.3 Predicting gains and losses

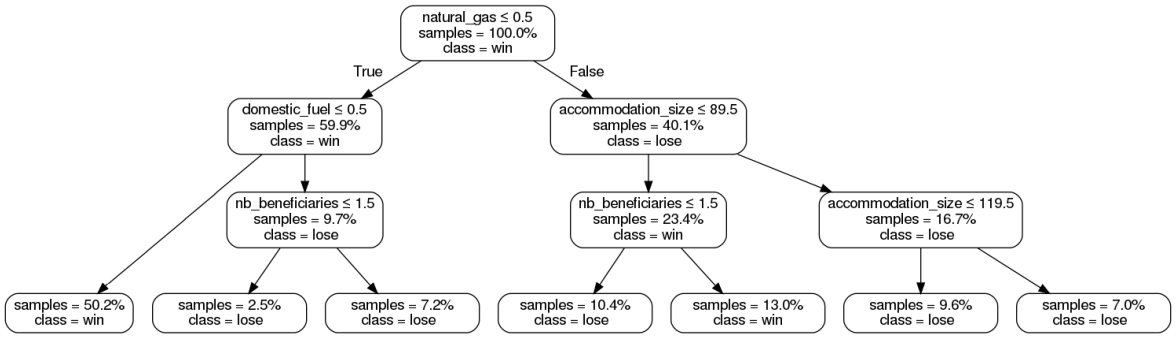
As explained in Section 2.3, to estimate respondents' bias and provide a customized feedback on their win/lose category, we need to estimate their increase in housing energy expenditures, $\Delta E_h^{housing}$, based on their energy characteristics.

To do so, we regress $\Delta E_h^{housing}$ on households' characteristics using the housing survey. Table C.1 presents several specifications for such regression, and its last row shows the out-of-sample error rate, computed with the consumer survey. All specifications yield a similar error rate of 15-17%. Fearing that respondents could make mistakes when filling the accommodation size in the entry field, we used the first specification in our survey, as it does not rely as heavily as the others on the accommodation size. In order to balance the error rates for losing households that are mistakenly estimated winners and for winners who are mistakenly estimated losers, we add a constant of 16.1 in our estimation of yearly net gain, which is thus the sum of 16.1 plus 110 times one or two (depending on the number of adults) minus increases in transport and housing energy expenditures. We selected OLS as our prediction method for the estimation of net gain because it compares well with respect to alternative methods. We also classified winners and losers using a decision tree, and obtained a very close error rate: 17.4% (see Figure C.1). Finally, statistical matching provided an error rate of 17.7%.

Table C.1: Determinants of housing energy expenditures.

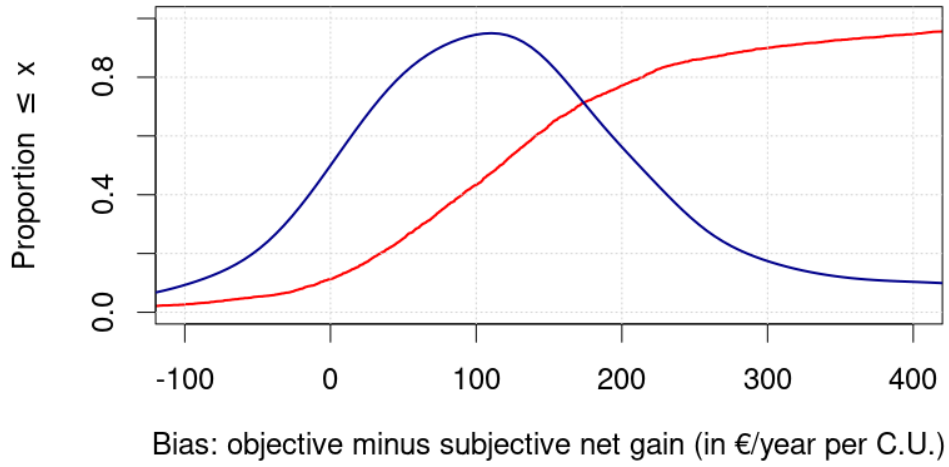
	Increase in housing energy expenditures (€/year)		
	(1)	(2)	(3)
Constant	−55.51		−0.634
	(1.237)		(1.489)
Housing energy: Gas	124.6		1.173
	(1.037)		(2.323)
Housing energy: Fuel oil	221.1	129.8	130.4
	(1.719)	(3.752)	(4.002)
Accommodation size (m^2)	0.652		0.024
	(0.012)		(0.015)
Accommodation size × Gas		1.425	1.397
		(0.007)	(0.024)
Accommodation size × Fuel oil		0.945	0.922
		(0.029)	(0.032)
Observations	26,729	26,729	26,729
R^2	0.545	0.716	0.599
Error rate	0.166	0.155	0.155

NOTE: The increase in energy expenditures is directly computed from households' energy bills in the housing survey, based on equation (11) in Appendix C.2. See discussion in the main text, Section 2.3.2 on page 17.



NOTE: This figure reads: the 50.2% of respondents who do not use natural gas nor domestic fuel (≤ 0.5) as their heating source are predicted to win from the Tax & Dividend.

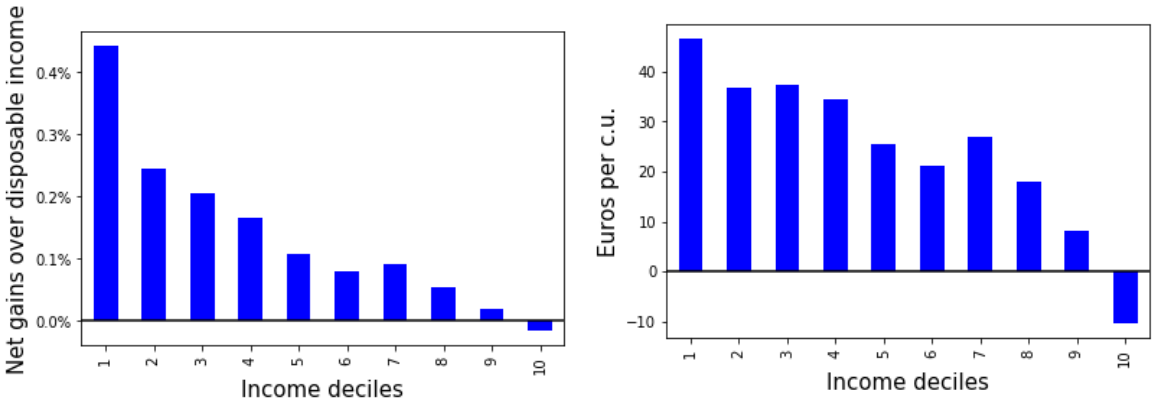
Figure C.1: Decision tree that classifies households between winners and losers.



NOTE: The red curve indicates for 11% of respondents, objective gains are lower than subjective ones, while for 23% of them they are higher by at least 200€. The blue curve indicates that the most common bias is an underestimation of gains by about 100€. See discussion in the main text, Section 3.1 on page 18.

Figure C.2: CDF (in red) and PDF (in blue) of the bias.

C.4 Distributive effects



NOTE: Net gains are defined in equation (13). They correspond to the dividend minus the increase in expenditures (ΔE), not in taxes (ΔT). Although the latter would sum to zero in aggregate because the reform is budget neutral, the former does not because fossil fuels expenditures adjust downwards following the increase in the carbon tax. See discussion in the main text, Section 3.3 on page 23.

Figure C.3: Average net gain of the carbon tax and dividend policy, by income decile (computed using Insee data).

D Beliefs and persistence

D.1 Elasticities

Table D.1: Effect of subjective elasticities on perceived environmental effectiveness.

	Environmental effectiveness: not 'No'			
	(1)	(2)	(3)	(4)
Price elasticity: Housing	−0.062		−0.055	
	(0.032)		(0.032)	
Price elasticity: Transports		−0.056		−0.060
		(0.030)		(0.030)
Controls: Socio-demo, energy incomes, estimated gains			✓	✓
Observations	1,501	1,501	1,501	1,501
R^2	0.003	0.002	0.089	0.090

NOTE: See discussion in the main text, Section 3.2 on page 22.

D.2 Self-interest

Table D.2: Transition matrix after telling respondents they are expected to *win* (75.8%).

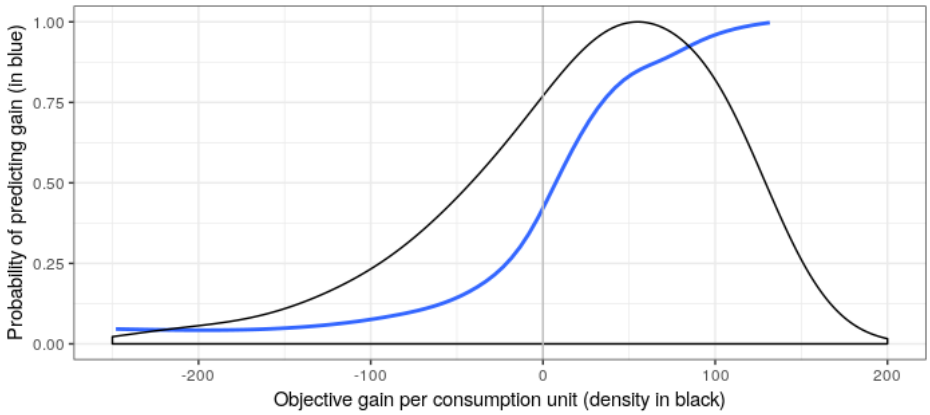
Before \ *After*	**Winner** (25%)	**Unaffected** (28%)	**Loser** (47%)
Winner (16%)	79%	13%	8%
Unaffected (24%)	22%	63%	15%
Loser (60%)	12%	18%	70%

NOTE: See discussion in the main text, Section 4.1.1 on page 24.

Table D.3: Transition matrix after telling respondents they are expected to *lose* (24.2%).

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

NOTE: See discussion in the main text, Section 4.1.1 on page 24.



NOTE: The black curve corresponds to the density of households' objective net gains in the consumer survey. As shown by the blue curve, households in the consumer survey who would gain 100€ per C.U. —as directly computed from their energy bills— were predicted to be winner —from their energy characteristics— in 96% of cases. See discussion in the main text, Section 4.1.1 on page 24.

Figure D.1: Probability that our net gains' estimation correctly predicts the win/lose category.

Table D.4: Share with new beliefs aligned with feedback, among those with large gain or loss ($|\widehat{\gamma}| > 110$).

	Aligned with feedback: $G^F = \widehat{\Gamma}$	
	win ($\widehat{\Gamma} = 1$) (81.6%)	lose ($\widehat{\Gamma} = 0$) (18.4%)
Initial belief winner ($g > 0$) (19.4%)	77.6% [68.5%;84.7%]	78.4% [43.2%;94.5%]
Initial belief unaffected ($g = 0$) (28.2%)	20.7% [14.8%;28.1%]	32.7% [14.7%;57.7%]
Initial belief loser ($g < 0$) (52.3%)	10.8% [7.3%;15.8%]	92.2% [84.5%;96.3%]
Initial belief affected ($g \neq 0$) (70.8%)	32.7% [27.7%;38.1%]	91.1% [83.5%;95.4%]
All (100%)	28.9% [24.8%;33.3%]	83.0% [74.8%;88.9%]

NOTE: The 95% confidence intervals for binomial probabilities are given in brackets. The Table reads as follows: among those who initially think they would win ($g^0 > 0$) but are told they are expected to lose ($\hat{\Gamma} = 0$), 78.4% agree that they would lose ($G^F = 0$). Compared to Table 4.1, this Table focuses on the sub-sample of people with large gain or loss ($|\widehat{\gamma}| > 110$)). See discussion in the main text, Section 4.1.1 on page 24.

D.3 Environmental effectiveness

Table D.5: Effect of primings on beliefs about environmental effectiveness

	Environmental effectiveness			
	not "No"			"Yes"
	OLS		*logit*	*OLS*
	(1)	(2)	(3)	(4)
Info on Environmental Effectiveness (Z_E)	0.043	0.063	0.052	0.059
	(0.017)	(0.018)	(0.018)	(0.014)
Info on Climate Change (Z_{CC})	0.044	0.041	0.043	0.029
	(0.024)	(0.024)	(0.024)	(0.018)
Info on Particulate Matter (Z_{PM})	0.039	0.029	0.037	0.017
	(0.024)	(0.024)	(0.024)	(0.019)
$Z_{CC} \times Z_{PM}$	−0.040	−0.033	−0.042	−0.005
	(0.035)	(0.034)	(0.033)	(0.027)
Controls: Socio-demo		✓	✓	✓
Observations	3,002	3,002	3,002	3,002
R^2	0.003	0.047		0.075

NOTE: See discussion in the main text, Section 4.2 on page 32.

D.4 Progressivity

Table D.6: Effect of information on perceived progressivity

	Progressivity: not "No" (P)		
	(1)	(2)	(3)
Constant	0.419	0.435	0.052
	(0.022)	(0.033)	(0.319)
Information on progressivity (Z_P)	−0.021	0.050	0.051
	(0.027)	(0.040)	(0.041)
Large bias ($\lvert\widehat{\gamma}-g\rvert > 110$)		−0.028	−0.040
		(0.045)	(0.045)
Interaction $Z_P \times (\lvert\widehat{\gamma}-g\rvert > 110)$		−0.130	−0.117
		(0.055)	(0.055)
Controls: Socio-demo, politics			✓
Observations	1,444	1,444	1,444
R^2	0.0004	0.018	0.094

NOTE: A large bias is defined as a difference between subjective (g) and objectively estimated ($\hat{\gamma}$) net gain larger than 110€/year per c.u. See discussion in the main text, Section 4.3 on page 32.

E Estimation of acceptation motives

E.1 Two-stage least squares: first stage results

Table E.1: First stage regressions results for self-interest

	Believes does not lose		
	Targeted Dividend (G^T)		After feedback (G^F)
	(1)	(2)	(4)
Transfer to respondent (T_1)	0.199	0.224	
	(0.034)	(0.030)	
Transfer to spouse (T_2)	0.172	0.156	
	(0.042)	(0.039)	
$T_1 \times T_2$	−0.145	−0.158	
	(0.045)	(0.037)	
Simulated winner ($\widehat{\Gamma}$)			0.269
			(0.058)
Initial tax Acceptance (A^0)	0.123	0.154	0.306
	(0.041)	(0.033)	(0.066)
Controls: Incomes (piecewise continuous) estimated gains, socio-demo, other motives	✓	✓	✓
Controls: Policy assigned	✓	✓	
Sub-sample	[p10; p60]		$\lvert\widehat{\gamma}\rvert < 50$
Effective F-Statistic	15.6	23.8	21.3
Observations	1,969	3,002	757
R^2	0.221	0.196	0.301

NOTE: In (1,2), the random eligibility to the dividend (conditionally on income) is used as source of exogenous variation in the belief. In (4), the discontinuity in the win/lose feedback when the net gain switches from negative to positive is used. Column numbers correspond to second stage results, Table 5.1 on page 36.

Table E.2: First stage regressions results for environmental effectiveness

	Environmental effectiveness	
	"Yes" (1; 3)	not "No" (A4)
Info on Environmental Effectiveness (Z_E)	0.059	0.062
	(0.014)	(0.017)
Info on Climate Change (Z_{CC})	0.028	0.030
	(0.013)	(0.017)
Controls: Socio-demo, other motives, incomes, estimated gains	✓	✓
Effective F-Statistic	11.2	6.0
Observations	3,002	3,002
R^2	0.123	0.121

NOTE: In column names, (A4) refer to columns of alternative second stages in Table E.5. The information randomly displayed about climate change (Z_{CC}) and the effectiveness of carbon taxation (Z_E) are used as sources of exogenous variation in the belief. We chose the set of instruments that maximizes the effective F-statistics. Our specification is well-founded as the Sargan test does not reject the validity of our over-identification restrictions (p-value of 0.93). See discussion in the main text, Section 5.2 on page 38.

E.2 Additional specifications

Table E.3: Effect of self-interest on acceptance: second stages of alternative specifications

	Targeted Dividend (A^T)			After Feedback (A^F)		
	Acceptance	Approval		Acceptance	Approval	
	(1)	(2)	(3)	(4)	(5)	(6)
Believes wins	0.574	0.357		1.131	0.609	
	(0.136)	(0.117)		(0.298)	(0.233)	
Believes does not lose			0.343			0.347
			(0.113)			(0.133)
Controls: Incomes (piecewise continuous) estimated gains, socio-demo, other motives	✓	✓	✓	✓	✓	✓
Controls: Policy assigned	✓	✓	✓			
Sub-sample: [p10; p60] (A^T) or $\lvert\widehat{\gamma}\rvert < 50$ (A^F)	✓	✓	✓	✓	✓	✓
Effective F-Statistic	21.3	21.3	15.6	11.4	11.4	21.3
Observations	1,969	1,969	1,969	757	757	757
R^2	0.321	0.217	0.217	0.541	0.518	0.518

NOTE: See results of main specifications, Table 5.1 on page 36. As in the latter Table, the source of exogenous variation in the belief used in first-stages for the targeted dividend is the random assignment of the income threshold, which determines eligibility to the dividend. The first-stage for the non-targeted dividend exploits instead the discontinuity in the win/lose feedback when the net gain switches from negative to positive.

Table E.4: Effect of self-interest on acceptance: the role of incomes

	Acceptance of Tax & Targeted Dividend (A^T)				
	(1)	(2)	(3)	(4)	(5)
Believes does not lose (G^T)	0.773	0.556	0.549	0.535	0.502
	(0.222)	(0.133)	(0.133)	(0.133)	(0.130)
Income above 35th percentile ($\mathbb{1}_{I>p35}$)	0.343				
	(0.508)				
$G^T \times \mathbb{1}_{I>p35}$	−0.392				
	(0.311)				
Initial tax Acceptance (A^0)	0.387	0.353	0.354	0.356	0.359
	(0.058)	(0.041)	(0.041)	(0.041)	(0.040)
Percentile with additional income slope change		30	40	50	60
Controls: Incomes (piecewise continuous)	✓	✓	✓	✓	✓
estimated gains, socio-demo, other motives					
Sub-sample: [p10; p60]; Controls: Policy assigned	✓	✓	✓	✓	✓
Effective F-Statistic	5.5	15.3	15.2	15.2	16.1
Observations	1,969	1,969	1,969	1,969	1,969
R^2	0.571	0.321	0.321	0.321	0.321

NOTE: See results of main specifications, Table 5.1 on page 36. The source of exogenous variation in the belief used in the first-stage is the random assignment of the income threshold, which determines eligibility to the dividend.

Table E.5: Effect of believing in environmental effectiveness on support: second stages of alternative specifications

	Initial Tax & Dividend				
	Approval ($\dot{A}^0$)		Acceptance (A^0)		
	logit	*LIML*	*OLS*	*IV*	*OLS*
	(A1)	(A2)	(A3)	(A4)	(A5)
Environmental effectiveness: "Yes"	0.293	0.643	0.367		
	(0.021)	(0.320)	(0.020)		
Environmental effectiveness: not "No"				0.479	0.413
				(0.230)	(0.015)
Instruments: info E.E. & C.C.		✓		✓	
Controls: Socio-demo, other motives	✓	✓	✓	✓	✓
Effective F-Statistic				6.0	
Observations	3,002	3,002	3,002	3,002	3,002
R^2		0.295	0.295	0.218	0.379

NOTE: Standard errors are reported in parentheses. For logit, average marginal effects are reported and not coefficients. The list of controls can be found in Appendix F, and the main results in Table 5.2 on page 39. As in the latter Table, the dependent variable corresponds to either initial approval (answer "Yes" to support of the policy) or acceptance (answer not "No"). The first stage exploits the information randomly displayed about climate change (C.C.) and the effectiveness of carbon taxation (E.E.) as exogenous instruments.

F Control variables

Socio-demo: *respondent's income, household's income, sex, age* (5 categories)*, employment status* (9 categories)*, socio-professional category* (8 categories)*, region of France* (10 categories)*, size of town* (5 categories)*, diploma* 4 categories*, household size, number of people above 14, number of adults, number of c.u., income per c.u., smokes, favored media for news* (5 categories)*.*

Politics: *extreme left, left, center, right, extreme right, interest in politics* (3 categories)*, conservative, liberal, humanist, patriot, environmentalist, apolitical.*

Political leaning: *extreme left, left, center, right, extreme right, indeterminate.*

Energy: *heating mode* (collective vs. indivual)*, heating energy* (7 categories)*, annual distance travelled, fuel economy, diesel* (binary)*, gasoline* (binary)*, number of vehicles.*

Incomes: *income of respondent, income of the second adult, income of respondent squared, income of the second adult squared, dummy for absence of second adult.*

Incomes (piecewise continuous): *income percentile of respondent* (I_1)*, income percentile of the second adult* (I_2)*, dummy for absence of second adult,* $\min(I_1 - 20, 0)$, $\min(I_1 - 70, 0)$, $\min(I_2 - 20, 0)$, $\min(I_2 - 70, 0)$.

Estimated gains: *simulated net gain, squared simulated gain.*

G Questionnaire (*For online publication*)

Priming

1. [No priming] Welcome to this survey.

   It was conceived by two researchers in social science. It lasts about 15-20 minutes.

2. [Info PM] Welcome to this survey.

   It was conceived by two researchers in social science. It lasts about 15-20 minutes.

   Before starting, please read carefully the information below on particulate matter pollution:

   - particulate matter are responsible for 48,000 deaths in France each year;
   - particulate matter reduce the life expectancy of French people by 9 months;
   - reducing fuel consumption would reduce the health problems associated with particulate matter.

   Source: France Public Health Report (2016)

3. [Info CC] Welcome to this survey.

   It was conceived by two researchers in social science. It lasts about 15-20 minutes.

   Please read carefully the information below on climate change.

   - Climate change is already responsible for 150,000 deaths annually.
   - If greenhouse gas emissions continue on their current trend, the average global warming will be +5°C in 2100 and +8°C in 2250.
   - A rapid transition to renewable energies is technically possible and would contain global warming at +2°C.

According to scientists, in the absence of ambitious measures:

- a large proportion of species face an increased risk of extinction;
- natural disasters will intensify (hurricanes, heat waves, droughts, floods, forest fires, etc.);
- by 2100, 270 million more people would be flooded each year due to sea-level rise;
- violent conflicts and migration flows can be expected to increase.

Sources: Burke et al (2009), Hinkel et al (2014), IPCC Report (2014), Meinshausen et al (2011), Patz et al (2005)

Socio-demographics

4. What is your postal code?

5. What is your gender (in the sense of civil status)?
   Female; Male

6. What is your age group?
   18 to 24 years old; 25 to 34 years old; 35 to 49 years old; 50 to 64 years old; 65 years old or more

7. What is your employment status?
   Permanent; Temporary contract; Unemployed; Student; Retired; Other active; Inactive

8. What is your socio-professional category? (Remember that the unemployed are active workers).
   Farmer; Craftsperson, merchant; Independent; Executive; Intermediate occupation; Employee; Worker; Retired; Other Inactive

9. What is your highest degree?
   No diploma; Brevet des collèges; CAP or BEP [secondary]; Baccalaureate; Bac +2

(BTS, DUT, DEUG, schools of health and social training...); Bac +3 (licence...) [bachelor]; Bac +5 or more (master, engineering or business school, doctorate, medicine, master, DEA, DESS...)

10. How many people live in your household? Household includes: you, your family members who live with you, and your dependents.

11. What is your net **monthly** income (in euros)? **All income** (before withholding tax) is included here: salaries, pensions, allowances, APL [housing allowance], land income, etc.

12. What is the net **monthly** income (in euros) **of your household**? **All income** (before withholding tax) is included here: salaries, pensions, allowances, APL [housing allowance], land income, etc.

13. In your household how many people are 14 years old or older (**including yourself**)?

14. In your household, how many people are over the age of majority (**including yourself**)?

Energy characteristics

15. What is the surface area of your home? (in m²)

16. What is the heating system in your home?
    Individual heating; Collective heating; PNR (Don't know, don't say)

17. What is the main heating energy source in your home?
    Electricity Town gas; Butane, propane, tank gas; Heating oil; Wood, solar, geothermal, aerothermal (heat pump); Other; PNR (Don't know, don't say)

18. How many motor vehicles does your household have?
    None; One; Two or more

19. [Without a vehicle] How many kilometers have you driven in the last 12 months?

20. [One vehicle] What type of fuel do you use for this vehicle?
    Electric or hybrid; Diesel; Gasoline; Other

21. [One vehicle] What is the average fuel economy of your vehicle? (in Liters per 100 km)

22. [One vehicle] How many kilometers have you driven with your vehicle in the last 12 months?

23. [At least two vehicles] What type of fuel do you use for your main vehicle?
    Electric or hybrid; Diesel; Gasoline; Other

24. [At least two vehicles] What type of fuel do you use for your second vehicle?
    Electric or hybrid; Diesel; Gasoline; Other

25. [At least two vehicles] What is the average fuel economy of all your vehicles? (in Liters per 100 km)

26. [At least two vehicles] How many kilometers have you driven with all your vehicles in the last 12 months?

Partial reforms [transport / housing]

27. Do you think that an increase in VAT would result in a loss of more purchasing power for your household than for the average French household?
    Yes, much more; Yes, a little more; As much as the average; No, a little less; No, a lot less; PNR (Don't know, don't say)

28. Do you think that an increase in [fuel taxes / taxes on gas and heating oil] would cause your household to lose more purchasing power than an average French household?
    Yes, much more; Yes, a little more; As much as the average; No, a little less; No, a lot less; PNR (Don't know, don't say)

29. The government is studying a fuel tax increase, whose revenues would be redistributed to all households, regardless of their income. This would imply:

- [an increase in the price of gasoline by 11 cents per liter and diesel by 13 cents per liter / a 13% increase in the price of gas, and a 15% increase in the price of heating oil];
- an annual payment of [60 / 50]€ to each adult, or [120 / 100]€ per year for a couple.

In terms of purchasing power, would your household be a winner or a loser with such a measure?

Winner; Unaffected; Loser

30. [*Winner* selected] **According to you, your household's purchasing power would increase:**

From 0 to [10·uc] € per year; From [10·uc] to [20·uc] € per year; From [20·uc] to [30·uc] € per year; From [30·uc] to [40·uc] € per year; More than [40·uc] € per year

31. [*Loser* selected] **According to you, the purchasing power of your household would decrease:**

From 0 to [15·uc] € per year; From [15·uc] to [40·uc] € per year; From [40·uc] to [70·uc] € per year; From [70·uc] to [110·uc] € per year; From [110·uc] to [160·uc] € per year; From more than [160·uc] € per year

32. If fuel prices increased by 50 cents per liter, by how much would **your household** reduce its fuel consumption?

0% - [I already consume almost none / I am already not consuming]; 0% - [I am constrained on all my trips / I will not reduce it]; From 0% to 10%; From 10% to 20%; From 20% to 30%; More than 30% - [I would change my travel habits significantly / I would change my consumption significantly]

33. In your opinion, if [fuel prices increased by 50 cents per liter / gas and heating oil prices increased by 30%], by how much would **French people** reduce their consumption on average?

From 0% to 3%; From 3% to 10%; From 3% to 10%; From 10% to 20%; From 20% to 30%; More than 30%

34. Do you think that an increase in taxes on gas and heating oil would cause your household to lose more purchasing power than the average French household?
Yes, a lot more; Yes, a little more; As much as average; No, a little less; No, a lot less; PNR (Don't know, don't say)

Tax & dividend: initial

35. The government is studying an increase in the carbon tax, whose revenues would be redistributed to all households, regardless of their income. This would imply:

- an increase in the price of gasoline by 11 cents per liter and diesel by 13 cents per liter;
- an increase of 13% in the price of gas, and 15% in the price of heating oil;
- an annual payment of 110€ to each adult, or 220€ per year for a couple.

In terms of purchasing power, would your household win or loser with such a measure?
Win; Be unaffected; Lose

36. [*Winner* selected] **According to you, your household's purchasing power would increase:**
From 0 to [20·uc] € per year; From [20·uc] to [40·uc] € per year; From [40·uc] to [60·uc] € per year; From [60·uc] to [80·uc] € per year; From more than [80·uc] € per year

37. [*Loser* selected] **According to you, the purchasing power of your household would decrease:**
From 0 to [30·uc] € per year; From [30·uc] to [70·uc] € per year; From [70·uc] to [120·uc] € per year; From [120·uc] to [190·uc] € per year; From [190·uc] to [280·uc] € per year; From more than [280·uc] € per year

38. [[empty] / Scientists agree that a carbon tax would be effective in reducing pollution.] Do you think that such a measure would reduce pollution and fight climate change?
Yes; No; PNR (Don't know, don't say)

39. In your opinion, which categories would lose [[blank] / purchasing power] with such a measure? (Several answers possible)
No one; The poorest; The middle classes; The richest; All French people; Rural or peri-urban people; Some French people, but not a particular income category; PNR (Don't know, don't say)

40. In your opinion, what categories would gain purchasing power with such a measure? (Several answers possible)
No one; The poorest; The middle classes; The richest; All French people; Urban dwellers; Some French people, but not a particular income category; PNR (Don't know, don't say)

41. Would you approve of such a measure?
Yes; No; PNR (Don't know, don't say)

Tax & dividend: after information

42. [Feedback] We always consider the same measure. As a reminder, it would imply:

- an increase in the price of petrol by 11 cents per liter and diesel by 13 cents per liter;
- an increase of 13% in the price of gas, and 15% in the price of heating oil;
- an annual payment of 110€ to each adult, or 220€ per year for a couple.

In five out of six cases, a household with the same characteristics as yours would **[win / lose]**. (The characteristics taken into account are: heating with [source] for a dwelling of [size] m²; [distance] km covered with an average consumption of [fuel economy] liters per 100 km).

Based on this estimate, do you now think that your household would be:
Winner; Unaffected; Loser

43. [Info on progressivity] On average, this measure would increase the purchasing power of the poorest households, and decrease that of the richest, who consume more energy.

    In view of this new information, do you think this measure would benefit the poorest?
    Yes; No; PNR (Don't know, don't say)

44. [No info on progressivity] Do you think this measure would benefit the poorest?
    Yes; No; PNR (Don't know, don't say)

45. In view of the above estimate, would you approve of such a measure?
    Yes; No; PNR (Don't know, don't say)

46. Why do you think this measure is beneficial? (Maximum three responses)
    Contributes to the fight climate change; Reduces the harmful effects of pollution on health; Reduces traffic congestion; Increases my purchasing power; Increases the purchasing power of the poorest; Fosters France's independence from fossil energy imports; Prepares the economy for tomorrow's challenges; For none of these reasons; Other (specify):

47. Why do you think this measure is unwanted? (Maximum three answers)
    Is ineffective in reducing pollution; Alternatives are insufficient or too expensive; Penalizes rural areas; Decreases my purchasing power; Decreases the purchasing power of some modest households; Harms the economy and employment; Is a pretext for raising taxes; For none of these reasons; Other (specify):

Tax & targeted dividend

48. The government is studying an increase in the carbon tax, whose revenues would be redistributed **to the [20 / 30 / 40 / 50]% of the poorest French people only**. This would imply:

- an increase in the price of gasoline by 11 cents per liter and diesel by 13 cents per liter;
- an increase of 13% in the price of gas, and 15% in the price of heating oil;
- an annual payment of [550 / 360 / 270 / 220]€ for each adult earning less than [780 / 1140 / 1430 / 1670]€ per month (welfare benefits included, before withholding tax);
- no compensation for the others.

We estimate that in your household, [number of recipients] persons would receive this payment.

In terms of purchasing power, would your household win or lose with such a measure?
Win; Be unaffected; Lose

49. Would you approve such a measure?
    Yes; No; PNR (Don't know, don't say)

Other questions The survey is completed by other attitudinal questions, treated in our companion paper, Douenne & Fabre (2020). Hereafter, we only describe questions that are used in the present paper.

50. Please select "A little" (test to check that you are attentive).
    Not at all; A little; A lot; Completely; PNR (Don't know, don't say)

51. Do you smoke regularly? *Yes; No*

52. How much are you interested in politics?
    Almost not; A little; A lot

53. How would you define yourself? (Several answers possible)
    Extreme left; Left; Center; Right; Extreme right; Liberal; Conservative; Liberal; Humanist; Patriot; Apolitical; Environmentalist

54. How do you keep yourself informed of current events? Mainly through...
    Television; Press (written or online); Social networks; Radio; Other

55. What do you think of the Yellow Vests? (Several answers possible)
    I am part of them; I support them; I understand them; I oppose them; PNR (Don't know, don't say)

56. The survey is nearing completion. You can now enter any comments, comments or suggestions in the field below.

H Profile of the Yellow Vests (*For online publication*)

Table H.1: Positioning towards Yellow Vests, per category.

	Opposed	Understands	Supports	Is part	PNR
Extreme-left (2%)	6%	26%	51%	12%	5%
Left (20%)	17%	36%	36%	5%	7%
Center (13%)	49%	30%	15%	2%	6%
Right (16%)	40%	32%	20%	3%	6%
Extreme-right (9%)	11%	28%	47%	10%	5%
Indeterminate (40%)	19%	32%	30%	4%	13%
Liberal (5%)	48%	26%	18%	2%	6%
Conservative (2%)	22%	28%	30%	10%	11%
Humanist (11%)	21%	35%	29%	5%	10%
Patriot (8%)	21%	27%	39%	7%	6%
Apolitical (21%)	21%	31%	32%	4%	12%
Environmentalist (15%)	17%	39%	27%	5%	12%
Rural (21%)	20%	31%	34%	6%	9%
<20k (17%)	24%	28%	34%	6%	9%
20-100k (14%)	22%	33%	32%	4%	9%
>100k (31%)	29%	34%	26%	3%	8%
Paris (17%)	28%	33%	25%	4%	11%
No diploma or *Brevet* (30%)	21%	29%	34%	5%	10%
CAP or *BEP* (24%)	23%	28%	36%	6%	7%
Baccalauréat (17%)	22%	35%	29%	4%	11%
Higher (29%)	32%	21%	36%	3%	8%
Age: 18–24 (12%)	23%	34%	27%	4%	12%
Age: 25–34 (15%)	21%	33%	28%	7%	11%
Age: 35–49 (24%)	25%	32%	29%	5%	9%
Age: 50–64 (24%)	21%	32%	36%	4%	7%
Age: $\geq$ 65 (25%)	32%	30%	28%	3%	7%
Income decile: 1	25%	33%	26%	3%	14%
Income decile: 2	18%	31%	35%	5%	11%
Income decile: 3	17%	31%	32%	7%	12%
Income decile: 4	15%	33%	37%	6%	9%
Income decile: 5	21%	29%	36%	5%	8%
Income decile: 6	26%	33%	29%	6%	7%
Income decile: 7	25%	36%	28%	4%	7%
Income decile: 8	31%	31%	28%	3%	8%
Income decile: 9	39%	32%	20%	3%	6%
Income decile: 10	47%	29%	15%	3%	6%
Female (52%)	21%	34%	29%	5%	12%
Male (48%)	29%	30%	31%	5%	6%
Average	*25%*	*32%*	*30%*	*5%*	*9%*

NOTE: The percentages in parenthesis express the weighted share of each category from our sample. See discussion in the main text, Section 2.1 on page 7.

I Support rates for Tax & Dividend policies (*For online publication*)

Table I.1: Support for Tax & Dividend policies at different stages of the survey.

	"Would you approve of this reform?"		
	"Yes"	"No"	"PNR"
Initial stage (A^0)	10.4%	70.3%	19.3%
After feedback (A^F)	16.8%	63.0%	20.2%
Targeted dividend (A^T)			
bottom 20% (A^T)	19.1%	63.2%	17.7%
bottom 30%	15.0%	66.0%	19.0%
bottom 40%	17.3%	67.6%	15.1%
bottom 50%	12.8%	73.3%	13.9%
all	16.1%	67.6%	16.2%

NOTE: The table reads as follows: at the initial stage, 10.4% of respondents approved a Tax & Dividend. After receiving a customized feedback (either win or lose), 16.8% of them approved it. When the dividend targets only people below the bottom 20% (to which the respondent or its spouse may be eligible or not), 19.1% of them approve it.

J Relation between support and belief in progressivity (*For online publication*)

Specifications used As noticed in Section 5.3, the ambiguous responses to our priming on progressivity do not allow us to perform an IV estimation to identify the causal effect of this motive. To explore how respondents' beliefs about progressivity relate to their support for the policy, we therefore estimate simple OLS and logit regressions. Even though we control for many variables, including beliefs over other motives of support, we may suspect that the coefficients obtained remain biased by omitted variables or reverse causality. They should

therefore be taken as partial correlations and not causal estimates.

We focus on the acceptance question *after information*, i.e. after asking whether the reform is progressive or not. Table J.1 presents the results of different regressions, depending on the set of controls and on the choice of variables. Columns (1)-(4) report regressions of acceptance on the broad definition of motives of acceptance: answers *not "No"* to progressivity, effectiveness and *not "lose"* to win/lose category. On the contrary, columns (5)-(6) use strict definitions for both approval and the covariates, where only *"Yes"* (or *"win"*) answers activate the dummy variables.

Results On average, believing that the reform is *not regressive* is associated with a higher *acceptance* rate by 56 p.p. (column 3), while believing it is *progressive* is associated with a higher *approval* rate by 48 p.p. (6). However, when one introduces other motives of acceptance and their interactions as covariates, with households characteristics as controls, one observes that the effect of progressivity is lower: its marginal effect at the sample mean — i.e. accounting for the average marginal effect of interaction terms — is 27 p.p.[31] To disentangle the link between beliefs over net gains and progressivity, we also include the interaction between progressivity and income as a covariate (2, 5). Although the coefficient is negative, in accordance with intuition, the effect is small and not significant. Finally, using the strict definitions of beliefs and approval yields a smaller correlation (6) but similar results when accounting for relevant controls (5), showing that the effects are not driven by a correlation between "PNR" answers. Overall, although these results are not causal, they suggest that the belief that the tax is progressive is associated with a higher support, all else equal.

[31] Although these results are not causal, they show that 90% of those who believe in the three motives approve of the policy, along with 65-75% of those who believe in two of them.

Table J.1: Support of the Tax & Dividend in function of beliefs in each motive.

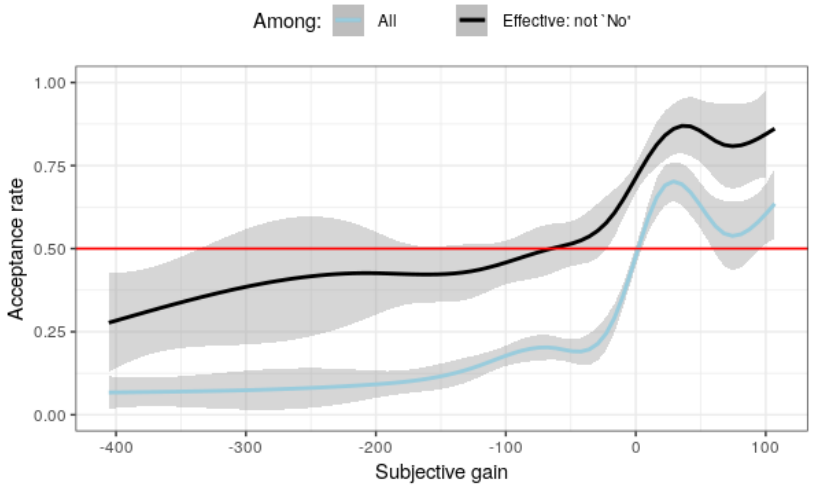
	Support (after information)					
	Broad definition of variables (*not "No"*)				Strict definitions (*"Yes"*)	
		OLS		*logistic*		*OLS*
	(1)	(2)	(3)	(4)	(5)	(6)
Progressivity (P)	0.223	0.237	0.560	0.544	0.228	0.482
	(0.038)	(0.044)	(0.023)	(0.019)	(0.041)	(0.023)
Winner (G^1)	0.332	0.332			0.303	
	(0.020)	(0.020)			(0.019)	
Effective (E)	0.258	0.259			0.244	
	(0.023)	(0.023)			(0.020)	
$(G^1 \times E)$	0.127	0.127			0.126	
	(0.034)	(0.034)			(0.037)	
Interaction: winner $(P \times G^1)$	0.183	0.183			0.098	
	(0.050)	(0.050)			(0.048)	
Interaction: effective $(P \times E)$	0.172	0.172			0.281	
	(0.057)	(0.057)			(0.059)	
Income (I, in k€/month)	0.017	0.018			0.037	
	(0.022)	(0.022)			(0.018)	
Interaction: income $(P \times I)$		−0.008			−0.019	
		(0.013)			(0.014)	
$P \times G^1 \times E$	−0.400	−0.399			−0.314	
	(0.072)	(0.072)			(0.083)	
Controls: Socio-demo	✓	✓			✓	
Observations	3,002	3,002	3,002	3,002	3,002	3,002
R^2	0.460	0.460	0.162		0.391	0.130

NOTE: Standard errors are reported in parentheses. For logit, average marginal effects are reported and not coefficients. The list of controls can be found in Appendix F. Covariates and dependent variables refer either to broad (1-4) or strict (5-6) definitions of the beliefs, where strict dummies do not cover "PNR" or "Unaffected" answers. See discussion in the main text, Section 5.3 on page 40.

K Willingness to pay (*For online publication*)

For respondents who believe in effectiveness of our Tax & Dividend, we are able to infer their willingness to pay (WTP) for climate mitigation by studying the acceptance rate in function of subjective gain. We adopt a common practice in the literature and define the WTP as the monetary loss that the *median* agent is willing to incur (Hanemann, 1984). Figure K.1 indicates that this WTP is about 60€/year per c.u., as this corresponds to the subjective loss below which a majority accepts the policy. This WTP is computed only among people who believe that the tax is not ineffective, as it would make little sense to assume that some people are willing to pay for an instrument that does not achieve its expected goal. Indeed, Figure K.1 shows that the "WTP" of the whole sample is zero, meaning that the median person accepts the policy only when they personally gain from it. Our method has several advantages. First, it can be interpreted as a willingness to accept as much as a willingness to pay, because our instrument is neither framed as a good to buy nor as damage to be compensated for, and net gains do not distinguish cost increases from payments received. Second, our method is more akin to revealed preferences — and hence probably less biased (Murphy et al., 2005) — than previous ones, because most studies directly ask respondents to select their preferred option for climate mitigation, be it in a contingent valuation method (Berrens et al., 2004; Cameron, 2005; Kotchen et al., 2013) or in a discrete choice experiment (Longo et al., 2008; Alberini et al., 2018). Still, our estimation has two notable limitations relative to the literature: it relies on a non-representative sub-sample, and subjective gains are endogenous with acceptance.

To compare our estimation with those of the literature, expressed per household, we have to multiply our WTP by the average number of consumption units by households: 1.6. The WTP per household we get, 96€, lies in the typical range of the literature (Jenkins, 2014; Streimikiene et al., 2019), suggesting that the protests against carbon taxation encountered in France do not reflect specific preferences for environmental policies.



NOTE: The black curve indicates that a majority of those who did not answer "No" to the question on the effectiveness of the policy accepted the reform when their subjective gain was above -60€ per c.u. For the whole sample (blue curve), this majority acceptance is reached only when subjective gains are positive.

Figure K.1: Acceptance rate by subjective gain, informative of the willingness to pay for climate mitigation.

L Ensuring data quality (*For online publication*)

We took several steps to ensure the best possible data quality. We excluded the 4% of respondents who spent less than 7 minutes on the full survey. We confirm that our main results are robust to choosing another cutoff than 7 minutes (see Table L.1). 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, which yields a final sample of 3,002 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 (and capped it to 12) and up to 273 respondents with inconsistent answers, such as a household income smaller than individual income, or a fuel economy higher than 90 liters per 100 km. Being flagged or response time are not significantly correlated with our

variables of interest such as policy support or subjective gain (the correlation is always between -1% and 3%). An examination of flagged answers suggests that these respondents have simply mistaken the question. Among these inconsistent answers, 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 annual incomes. We have divided these figures by 12.

Table L.1: Robustness of main results to the exclusion of answers of poor quality.

	Acceptance (A^T)			Correct updating (U)		
	all	> 11 min	not flagged	all	> 11 min	not flagged
Believes does not lose (.53)	0.526	0.547	0.558			
	(0.134)	(0.137)	(0.153)			
Winner, before feedback (.55)				0.542	0.532	0.553
				(0.083)	(0.085)	(0.091)
Initial tax: Approves (.18)				0.180	0.213	0.197
				(0.046)	(0.049)	(0.049)
Original regression: Table (column)	5.1 (1)	5.1 (1)	5.1 (1)	4.2 (2)	4.2 (2)	4.2 (2)
Effective F-statistic	15.2	14.5	11.8			
Whole sample size	2777	3165	2729	2777	3165	2729
Observations	1,978	1,825	1,826	1,370	1,261	1,242
R^2	0.320	0.318	0.326	0.142	0.150	0.155

NOTE: Two of our main results are checked on three alternative sampling restrictions: (1) inclusion of answers < 7 min, (2) exclusion of the 10% of answers < 11 min, (3) exclusion of flagged (inconsistent) respondents. Weights have been recalculated for each sample. Estimates on the original sample are reported next to variable name. See the original Tables for more details. Correlation between our main variables of interest and response time or being flagged is always below 3%. Standard errors are reported in parentheses.