Correcting Consumer Misperceptions about CO_2 Emissions *

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Abstract

Policy makers champion information provision about carbon impact, on the premise that consumers are willing to mitigate but are poorly informed about how to do so. We empirically test this argument and reject it. We collect an extensive new dataset and find both large misperceptions of carbon impact and clear preferences for mitigation. Yet, in two separate experiments, we show that large belief corrections have no effect on consumption in a large representative sample. Our null result is well-powered and highly informative, as we target information for maximal impact. It questions the potential of information policies to fight climate change.

JEL Classification codes: C81, C93, D84, Q54
Keywords: climate change, carbon emissions, information provision, consumer behavior

1 Introduction

Reducing the emission of greenhouse gases is one of the most pressing challenges of our time. Carbon pricing, a potential remedy, is politically contentious. Thus, policy makers frequently stress the role of information about CO_2 emissions to consumers and producers. Underlying these information initiatives is an implicit argument: It presumes that people care about reducing emissions but that they do not have sufficient awareness of climate impact and may underestimate the impact of their actions. From these premises, it follows that when misperceptions about emission sizes are corrected, consumers adjust their behavior and reduce emissions. Indeed, the Commission states in relation to the green transition that it "aims to ensure [...] that consumers have better information to be able to make an informed choice."

In this paper, we test this argument empirically and show that it is flawed. To do so, we proceed in several steps. First, to test the argument's premises, we survey a representative sample of US consumers. We collect point estimates and belief distributions about the carbon impact of several products and actions. We then measure valuations of carbon emissions for the same consumers, using a willingness to pay for different amounts of carbon offsets. We find that consumers generally underestimate carbon impact. Valuations of carbon emission reductions are relatively high, but the marginal willingness to mitigate declines strongly with emission size.

We leverage these data to develop the strongest possible test of the effect of information on consumer behavior. We use a structural model where consumers derive disutility from

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the (expected) emissions linked to their actions. We compare the individual disutility of consumption given a person's subjective beliefs about emissions, with a counterfactual where the belief distribution is replaced by the true value of emissions, as measured by the latest scientific estimates. The predicted information impact is based on consumers who are both uninformed and willing to mitigate, and it takes into account the degree of uncertainty among consumers and the (diminishing) responsiveness to emission size. The model allows us to predict the products for which information provision generates a maximal behavioral response.

Finally, we test our predictions in two experiments, each in a large representative sample. Our experiments focus on the demand for beef and poultry. Our participants understand that beef is more polluting than poultry, but they think that the difference between them is much smaller than it actually is. In line with this, our structural model, applied to the representative survey data, predicts that information on beef should have a large impact on demand. Instead, the impact on demand by providing information on poultry should be small or non-existent.

While our intervention successfully corrects misperceptions, we find no change in the demand for either beef or poultry. This null result is true for all subgroups in our sample and robust among those whose beliefs responded to the intervention. Our design allows us to rule out that this result is driven by pessimism about substitute products, by meat-eaters being already well informed, by an overly noisy measure of demand, or by a non-replicable statistical fluke. We also rule out behavioral channels like an intention-action gap.

We conclude that even successful corrections of underestimations do not increase voluntary mitigation in our representative samples. This refutes the conclusions of the policy maker's implicit argument, as well as the standard intuitions of economic decision making embodied in our model.

2 Climate Survey

Our initial survey ($N = 1,022$) measures consumers' existing beliefs about CO_2 emissions generated in the production of common consumer goods, as well as their willingness to pay to avoid CO_2 emissions using incentive-compatible payment schemes. These quantities subsequently serve as inputs for a structural model that allows us to make predictions about the provision of information. The first task asked general questions about climate change facts and the social cost of carbon. The next two tasks focused on eliciting beliefs, where we collected both point beliefs and belief distributions of CO_2 emissions from 12 common consumer products and activities. The last task elicited willingness to pay for mitigating CO_2 emissions ("willingness to mitigate"). After participants completed all four tasks, we asked them about their demographics and revisited the products and activities from tasks two and three to ask them about their consumption frequency in these categories.

Results. Figure 1A plots reported beliefs against scientific estimates of CO_2 emissions. Median beliefs lie below the identity line for all but one products, indicating that participants underestimated the size of CO_2 emissions. This is in line with findings in Camilleri et al. (2019),

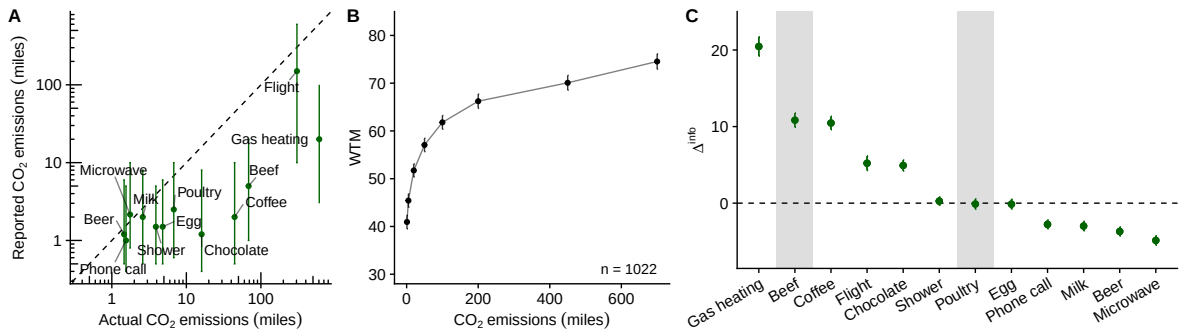

Figure 1: (A) Summary statistics of reported CO_2 emissions (median and IQR). (B) Concave WTM (mean and SEM). (C) Predicted effect of information provision Δ_k for each product (mean and SEM).

despite differences in the sets of products, elicitation methods, and the reference items.

We elicited WTM for eight levels of CO_2 emissions, that correspond to emissions generated by driving 1, 5, 20, 50, 100, 200, 450, and 700 miles by car. On average, participants have positive and sizable WTM for all levels of CO_2 emissions, and they exhibit a concave pattern (Figure 1B). Moving from emissions equivalent to driving 5 miles to 20 miles, a four-fold growth, increases the WTM by \$6.3 on average, while moving from 5 to 200 miles, a jump 10 times as large as the previous one, pushes the average WTM by only \$20.8. The marginal willingness to pay for mitigation decreases as the emission size increases, confirming findings in Pace and van der Weele (2020).

Modeling the impact of information. We combine beliefs about the impact and WTM and produce a prediction about the resulting consumer decision. The key assumption of our framework is that consumers suffer a cost from the expected emissions produced by their actions and that they make utility-maximizing decisions about the quantities of emissions.

Given a WTM function and a subjective belief distribution about CO_2 emissions associated with a good or activity, we can calculate the *expected WTM*. This quantity captures the extra amount of money a consumer is willing to pay in order to consume an imaginary, "carbon-neutral," version of the good or activity, taking into account the lack of knowledge about the actual size of CO_2 emissions. We model an *information policy* as a device that shifts consumers' beliefs about CO_2 emissions associated with a good. Let Δ_{ik} denote the difference in expected WTM before and after information for each consumer i and product k. If $\Delta_{ik} > 0$, information raises the psychological cost from consuming a unit of good k for consumer i through a change in her beliefs. If this increase is large enough, information may result in a change in consumer i's buying behavior. Finally, we define the effect of information provision on the consumption of good k, Δ_k, as the sample average of Δ_{ik} with respect to a reference group of agents.

We calculate our measure of the effect of information provision using the data from the survey (Figure 1C). We observe a substantial variation in the effect of information provision. We expect a positive effect for five products (gas heating, beef, coffee, flight, chocolate), no effect for three products (shower, poultry, egg), and a negative effect for four products (phone call, milk, beer, microwave).

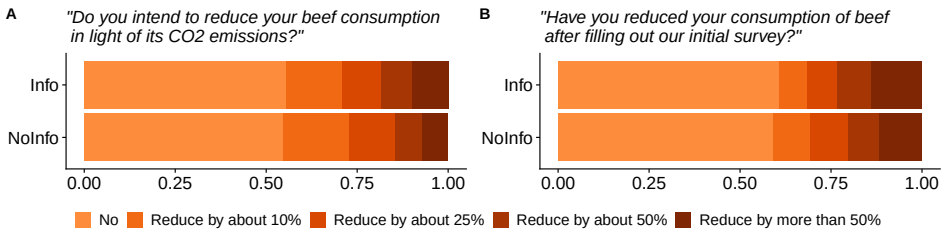

Figure 2: Impact of information on intentions and consumption across treatments. *Notes*: (A) Intentions to reduce beef consumption reported in Session 1, after information provision in the *Info* treatment. (B) Actual consumption changes in Session 2.

3 Information Experiments

To test the predictions we derive from our calibrated structural model, we compare the effect of information between beef and poultry meat. These products have very different predicted effects of information provision despite their similarity. While the predicted effect of information on beef consumption is among the very highest on our product list, it is approximately zero for poultry. The main hypothesis is that information provision about carbon impact will have a bigger impact on consumer demand for beef products than for chicken products.

The first experiment takes part in the context of the climate survey, where we informed some subjects about the true impact and measured changes in self-reported consumption two weeks later. The second experiment involves a new sample, where we study an incentivized choice to buy meat from an online butcher.

Survey experiment. This experiment took place with the participants of the climate survey described above. After the WTM elicitation, participants received information about the emissions associated with a few products randomly selected from the 12 products in our survey. The information consisted of the latest scientific estimate for the carbon impact of the product. Our treatments are thus on the subject-product pair level. We called back participants about two weeks later and elicited participants' beliefs about the emissions of the 12 products, some of which they may have been informed about, using the exact same procedures. Finally, we asked subjects whether they changed their consumption of any of the products in light of the carbon impact.

We find that information still affected beliefs two weeks later—beliefs have shifted and underestimation is reduced, although only a small minority remembers the actual value and a large majority still underestimates the impact of beef. However, in contrast to our hypothesis (following the predictions in Figure 1C), there is no discernible difference between the treatment and the control condition for beef (Figure 2). Thus, we conclude that belief changes did not translate into intentions to reduce the consumption of either meat product, nor into reductions in actual consumption. This evidence is all the more striking since behavior is self-reported, so it would have been cheap for subjects to report a socially desirable change.

Butcher experiment. Our goal in this experiment is to provide evidence on the role of information in an actual consumption decision. We offered participants ($N. = 2,081$) an

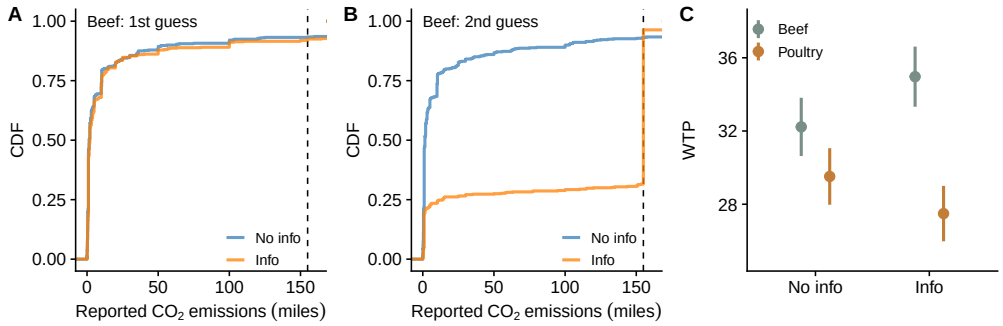

Figure 3: (AB) Beliefs about CO_2 emissions from beef product. (C) WTP for the meat product.

opportunity to purchase a bundle of high-quality meat products worth \$100, either 10 beef sirloin steaks or 10 skinless chicken breasts.

We varied between subjects whether the participants received information on the CO_2 emissions associated with beef and poultry meat (Info treatment) or not (NoInfo treatment). As in the climate survey, we provided the information in terms of the number of miles by car one needs to drive to emit as much as 1 lb of meat. We pinned down participants' beliefs about the car CO_2 emissions by including a scientific estimate of these emissions in the instructions. In this way, we made sure that our information treatment could only impact the beliefs about the meat. The information about car emissions was available in all treatments.

After showing a description of the bundle the participants could purchase, we asked the participants to guess the CO_2 emissions associated with the production and distribution of 1 lb of the type of meat that they were offered. As in the climate survey, participants expressed their guesses in terms of CO_2 emitted by driving one mile by car.

The participants in the Info treatments were informed about the emissions associated with the meat product they could purchase. To make sure that the participants paid attention to the information, we asked them to identify the true size of the emissions among three possible options. The participants in the NoInfo treatments, instead, saw three random numbers and answered a similar question.

We then elicited participants' WTP using a multiple price list. After completing the MPL task, we asked participants to guess one more time the size of the emissions associated with the meat product they had the opportunity to purchase.

As in the climate survey, participants exhibited a significant underestimation of the size of CO_2 emissions from beef and poultry. Participants were initially equally uninformed about CO_2 emissions across treatments for both meat products (see Figure 3A for beef). Providing information successfully shifted the beliefs of many participants in the treated groups, as evident in jumps in the distributions of posterior beliefs (asked after WTP; see Figure 3B for beef).

Remember that our model predicts that information has a positive impact in the direction of reducing the demand for beef but has no impact on the valuation of poultry. In the experiment, these predictions are translated into a *decrease* in average WTP for the beef bundle and no effect for the poultry bundle. These predictions are not supported in the data. Figure 3C shows the WTP for meat products by treatment. If anything, there is a small *upward*

movement in the valuation of the beef package after information provision. Average WTPs are not significantly different between treatments for both products (beef: $t(1046) = -1.200$, $p = 0.230$; poultry: $t(1031) = 0.938$, $p = 0.349$).

4 Conclusion

We used incentivized surveys to elicit both beliefs about the carbon impact of consumer products and the valuation of this impact. We find that most consumers underestimate the impact, but heterogeneity is large. While they are willing to pay to offset carbon emissions, this willingness is highly concave and varies by subgroups. We use these inputs in a simple structural model to predict the impact of information. In two experimental tests, we find no support for our predictions: despite a correction in the beliefs about beef meat, subjects are unresponsive in their valuations of beef products or their intentions to reduce consumption.

Our results show that correcting consumer beliefs does not necessarily lead to lower demand for carbon-intense consumer products, even in settings where misperceptions are large, and consumers indicate that they are interested in offsetting emissions. The results suggest that the climate impact of behavior is not a strong motivating force for most consumers in our experiment in everyday consumption decisions.

Our results also speak to the implications that can and cannot be drawn from existing evidence. First, we see our findings as consistent with those of studies that show the effects of climate labels, which are often small and short-lived. Our results suggest that behavioral effects from such labels are not primarily driven by changes in individual beliefs, but by other channels, such as an increase in the salience of the climate change phenomenon, or social norms of mitigation, both of which were kept constant in our experiment. In addition, our representative sample differs from that in most previous studies, which often use university canteens, supermarkets or restaurants, that may attract a particular segment of the population.

Second, evidence of widespread misperception of the climate impact of different consumption behaviors has sometimes been used to argue that information campaigns can lead to meaningful change. We show that this conclusion may be too optimistic. Similarly, other papers have investigated attitudes toward climate change by using donation decisions, willingness to mitigate, and survey responses. The results from these papers may be important in their own right, but our results temper confidence that these measures translate directly into everyday behavior like food consumption.

References

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