

# Recycling Behavior and Convenience



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## 1 Introduction

This chapter provides a comprehensive review of the current state of California's recycling policies. Specifically, we focus on the demand side of the recycling system and summarize some of the evidence around the efficacy of the California Department of Recycling's (CalRecycle) deposit-refund recycling program – in conjunction with other recycling alternatives, such as curbside recycling pickup – in providing convenient recycling options to consumers. In Sect. 2, we provide some relevant background on recycling policy in California. In Sect. 3, we discuss the findings in Berck et al. (2021), which uses survey data to empirically assess who recycles and how the public defines convenience in recycling opportunities. Next, in Sect. 4, we present the main takeaways from Berck et al. (2020), which focuses on the consumer survey evidence to estimate California residents' preferences and willingness to pay (WTP) for current beverage container recycling methods,

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including curbside pickup services, drop-off at government-subsidized recycling centers, and drop-off at non-subsidized centers. Finally, in Sect. 5, we discuss avenues for future research.

## 2 Background: Recycling Policies and the California System

A key policy goal in California since the late 1980s has been to increase consumer recycling, given the detrimental effects of trash and litter on the environment. To encourage recycling and reduce litter, California implemented AB 2020, informally known as the “Bottle Bill,” in 1987. The aim of AB 2020 was to increase the recycling rate of all recyclable containers to 80%. Much like other deposit-refund programs in the United States, the Bottle Bill requires consumers to pay a small deposit for each eligible beverage container at the time of purchase (currently 5 cents for containers smaller than 24 oz. and 10 cents for larger containers). When the container is empty, the consumer may take it to a state-certified recycling center and receive a refund of the deposit. This refund is the California Redemption Value (CRV) payment. The idea behind such deposit-refund programs is that the ability to collect the CRV payment will induce greater recycling.

While all California beverage retailers are required to charge the CRV deposit to the consumer, they are not directly required to handle container returns or to disburse CRV payments. This is unlike many other deposit-refund programs, where retailers are also obligated to collect containers and pay the redemption value, and beverage distributors must then recycle these containers. In many other states and countries, beverage retailers are also return sites, so as not to place an additional burden on low-income consumers for whom it may be costly to travel to a recycling

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center or other location to obtain their refund. Beverage retailers are convenient by definition; if a consumer can easily purchase a beverage somewhere, then they can likely easily return the container there as well.

Instead, California decided to rely mainly on its existing recycling center infrastructure to serve as container collection points and disburse CRV refunds. California's policy anomaly was largely a product of strong lobbying on the part of the beverage and supermarket industries, which were worried that such collection processes would be unduly costly in such a large state. Absent a retailer collection requirement, the program established "convenience zones" – a half-mile radius around any supermarket with \$2 million or more in annual sales – requiring that there be a recycling center within each zone. When this requirement is not met, the retailer must either take back the containers and pay the CRV to the consumer, pay a \$100 per day fine, or obtain an exemption. A fundamental tenet of the Bottle Bill was that retailers traded the obligation to take back containers against an obligation to provide for convenient recycling by another entity.

Under this system, all recycling centers that participate in the CRV program receive a "processing" payment from the state. These payments are calculated using a cost survey administered to a random sample of centers every several years and applied to all centers regardless of size and location. This method of calculation is prone to disadvantage smaller centers that are unable to take advantage of the economies of scale exhibited by larger centers.

Centers that are the first to be located in a convenience zone receive an additional payment from the state, called "handling fees," to help them stay operational, as many such centers would not be profitable to operate without these additional subsidies. Hence, we refer to centers in these convenience zones as "handling fee centers." We refer to other recycling centers as "processing fee" centers.

In terms of a container's return pathway under this regime, certified recycling centers (both handling fee centers and others) collect eligible containers and disburse CRV payments to consumers. The center then sells its containers to a processor. Processors pay the recycling centers the CRV, an administrative fee, and the processing payment and handling fees from the State Beverage Container Recycling Fund. The Recycling Fund is made up of consumer CRV payments, less an administrative fee, from beverage manufacturers who collect the deposits, as well as a processing fee paid by the manufacturers.

The goal of having convenience zones and handling fee centers is to make sure that, when imposing a CRV deposit, all consumers have convenient access to their refund, even when retailers do not disburse the CRV refunds. Yet, at the same time, many California consumers have access to alternative recycling methods, such as curbside pickup and recycling at locations outside of their home (such as their place of work or businesses they are patronizing). While these options may be convenient in the sense that there is generally less additional travel involved with returning cans, consumers also forfeit their CRV refund when recycling using these methods. Hence, even among consumers who choose to recycle, we may expect that consumers face different trade-offs in choosing a recycling alternative. For instance, we may expect that poorer consumers might be more inclined than more affluent

consumers to recycle at a center to reclaim their CRV deposit, at any convenience level. Similarly, it is also a prevalent practice for so-called scavengers to collect CRV-eligible containers from others' recycling or trash bins and recycle them at a center to redeem the CRV. This practice, induced by the deposit-refund system, may not actually increase recycling but rather changes the recycling method. Hence, in the evidence to come, we also take note of important sources of heterogeneity between consumers and how convenience-related attributes may differentially affect recycling behavior.

### **3 Defining Convenience: Evidence From Two Surveys**

To analyze whether recycling is convenient for consumers requires an understanding of how consumers define the convenience of a recycling option. Specifically, it is key to identify attributes of a recycling center visit that consumers value. To identify such attributes, Berck et al. (2021) conducted two surveys of Californians about beverage container recycling. The first survey (which we refer to as the “AmeriSpeak survey”) was administered primarily online and is representative of all Californians. The second survey (which we refer to as the “intercept survey”) was conducted at recycling centers and is representative of trips made by users of those centers.

#### ***3.1 AmeriSpeak Survey***

AmeriSpeak, managed by NORC at the University of Chicago, is a representative panel of the United States, with over 2800 participants from California, who earn rewards for participating in surveys. NORC ensures representative responses by allowing respondents to respond over the internet or by telephone (to make sure to capture populations that may not have access to the internet) and by providing versions of the surveys in both English and Spanish (to make sure to capture the sizable Spanish-speaking population in California). NORC also has protocols for encouraging responses, if needed, and weighting the responses to make the responses representative. One thousand AmeriSpeak participants were targeted to participate in the survey, chosen to maintain representativeness. Notably, a survey of 1000 California households has a fairly low error rate of 3% with a 90% confidence level.

#### ***3.2 Intercept Survey***

Our team conducted the intercept survey at randomly selected recycling centers throughout California. Surveyors asked recyclers 25 questions regarding their

recycling habits and requested a copy of their recycling transaction receipt. The intercept survey is an important complement to the AmeriSpeak survey, as we also wanted to learn about people who recycle frequently, such as people who divert containers from the trash or from curbside collection (i.e., “scavengers” who collect others’ unredeemed containers out of recycling or trash bins to claim the CRV). Sampling people who come to centers provides more observations on “scavengers” and other frequent recyclers. As discussed below, people who make the trip to recycling centers in order to collect refunds tend to be lower-income than people who use curbside recycling, and people who divert recyclables from bins or garbage cans tend to be lower-income still.

The survey included 628 participants at 88 recycling centers. The survey was designed to have an error rate of 10% with 90% confidence under an assumption that the people surveyed in each recycling center would not be completely independent draws.

### ***3.3 Definition of Convenience***

Data from both surveys were used to determine an appropriate definition of convenience. Respondents from the AmeriSpeak survey listed “nearby” (73%) and “extended hours of operation” (48%) as the top two reasons for choosing particular recycling centers. In addition, although 41% of AmeriSpeak respondents who visit recycling centers use centers in convenience zones, only 17% of respondents stated that having a recycling center in their store parking lot was important to them, suggesting that handling fee centers may not be essential for many households.

Similarly, in the intercept survey, 70% of respondents listed “close to home or work” as their top reason for selecting a recycling center. “Open at good times” (21%) as well as “short lines” (18%) were also key factors. Seventy-five percent of recyclers are aware of other centers available to them and selected a recycling center with an average wait time of ten minutes.

Combining evidence from both surveys, we define convenient recycling opportunities as recycling centers that are close to home or work, open at good times, and have short wait lines. We next explore each aspect of this definition and try to understand whether the current recycling experience is meeting this definition.

### ***3.4 Close to Home***

It should be noted that almost all Californians also have access to a curbside recycling program, which cities create to decrease the material sent to landfills. The respondent group that did not take their recyclable materials to a recycling center reported that they felt it was not worth the money, although the time and effort

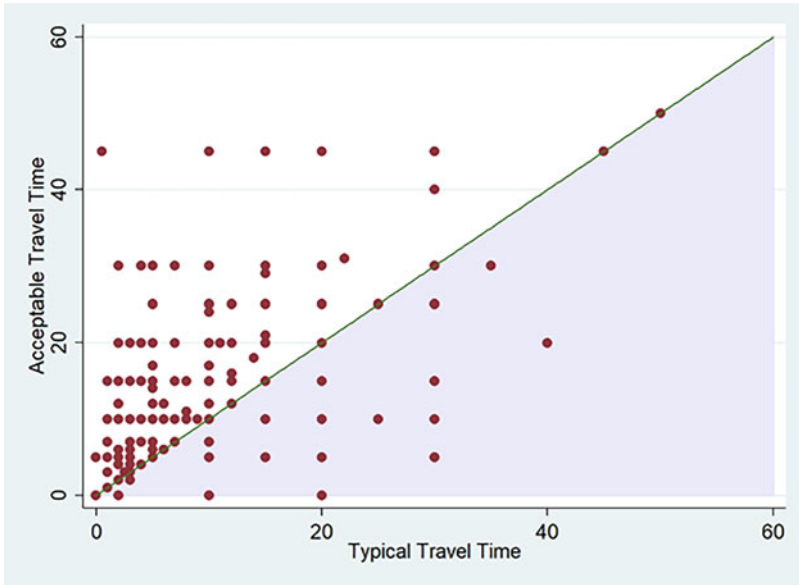


Fig. 1 Travel time plotted against acceptable travel time. (Berck et al. 2021)

required to sort the material and take it to the center were regularly cited reasons as well.

On average, people live 2.73 miles away from their closest recycling center. For people who responded that they do not go to a recycling center because they live too far away from their nearest center, the average distance to the nearest center was 3.39 miles.

In order to understand how much of a barrier proximity may be to reaching a recycling center, we also consider how consumers travel to recycling centers. The AmeriSpeak survey found that driving to a center is the most common mode of transport, identified by 93% of AmeriSpeak respondents who recycled at centers. Similarly, in the intercept survey, 85% of respondents drove to the recycling center. The next most popular mode of transportation was walking, with 9% of respondents. Notably, as respondents do not tend to report using public transit to visit centers, we do not need to be concerned about whether centers are accessible via public transportation.

Next, we consider whether current time spent traveling to centers is in a range that consumers find acceptable and convenient. In Fig. 1, created using data from the intercept survey, we look at people's stated "acceptable" travel time versus their current travel times. Plotted points that fall above the 45 degree line correspond to people who find their current travel time to be acceptable, while points that fall below the 45 degree line correspond to people who are currently traveling longer than they believe is acceptable.

In Fig. 1, we see that frequent recyclers typically travel what they view as an acceptable amount of time and indicate that they would be willing to travel farther. The average time individuals typically travel to recycle is 10 minutes, while the median is 5 minutes. People also responded with a mean willingness to travel of 15 minutes and median of 10 minutes. Hence, we can see that most people are traveling less than what they consider an acceptable distance and can conclude that there are currently convenient recycling opportunities in this dimension.

### ***3.5 Open at Good Times***

Though we do not necessarily know what constitutes a “good time” for any individual consumer, one way to assess the convenience of center hours (at least for handling fee centers) is to see whether they are open at similar times as the grocery stores that they are close to. If they are open at similar times, then consumers can presumably do their shopping and recycle their containers in one trip (similar to the convenience achieved if the supermarket itself accepted container returns). Handling fee centers are required to be open for at least 30 hours per week. To show the typical hours of operation, we sampled 19 recycling centers and their nearby supermarkets on two days: a Wednesday and a Sunday. We recorded their open hours from CalRecycle records and their travel frequencies from Google Analytics. We find that most of the surveyed handling fee centers are indeed open on Wednesdays, but they tend to be open in the morning, the time of day when supermarkets are least trafficked. Specifically, a typical handling center is open from 8 am to 5 pm on Wednesdays, whereas supermarkets have their highest traffic levels from 1 pm to 8 pm. Notably, these hours may be inconvenient for much of the working population, who have to work until 5 pm.

On Sundays, many recycling centers are open for most of the day, i.e., 9 am to 4 pm on average. However, this is not necessarily the case for handling fee centers. Supermarkets generally are open on Sundays, and this is a popular shopping day, which would make Sundays potentially convenient for those who cannot recycle during the week. Yet, less than 50% of handling fee centers are open on Sundays. Hence, it may not be the case that all consumers have access to an open center at convenient times. This finding calls into question whether subsidies to handling fee centers are achieving the legislature’s goal of making it easy for consumers to return containers and get their deposit at the same time that they are making shopping trips.

### ***3.6 Short Wait Times***

Figure 2 presents similar results as Fig. 1, except here we focus on whether individuals find current wait times acceptable. Notably, this data follows a similar pattern as well. Individuals report that they are willing to wait longer at recycling

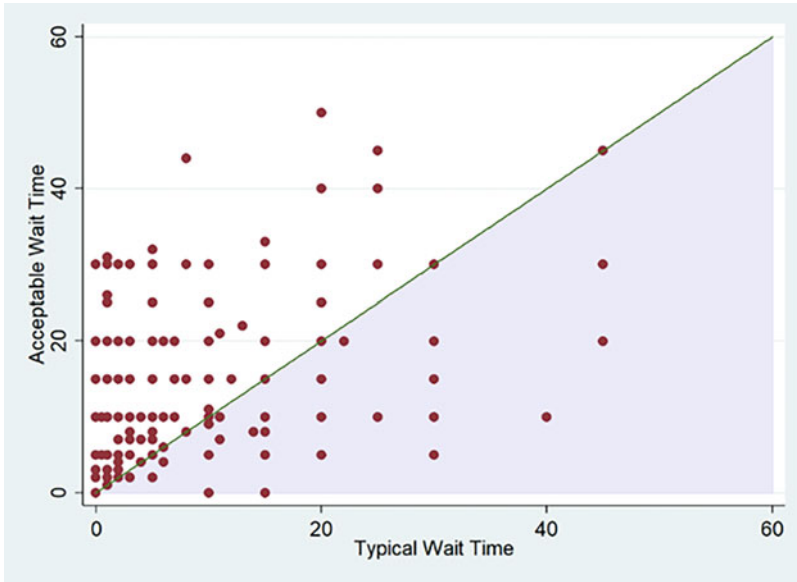


Fig. 2 Wait time plotted against acceptable wait time. (Berck et al. 2021)

centers than their current typical wait times. On average, people wait 10 minutes (median: 5 minutes) at a recycling center. They are willing to wait an average of 16 minutes (median: 10 minutes) to recycle.

### 3.7 Diversity in Recycling Behavior

We notice from the above analysis that those who do use recycling centers seem to find recycling generally convenient and worth their time, as we might expect. Yet of course not everyone in the AmeriSpeak sample chooses to use a recycling center; about 23% of households reported visiting a recycling center in the past week, and 43% report saving containers to redeem later. This is compared to 32% of respondents who report using curbside recycling and 5% who report recycling at a business or place of work outside their home. Notably, those who report using the latter two options are richer and more educated than those who use recycling centers. Yet availability of curbside service is likely not the primary reason for this difference, as 97% of areas where respondents reside offer at least some type of curbside service, and only 16% of respondents report not having access to curbside recycling. Hence, it is indeed likely that, at the current level of convenience, less affluent households have lower opportunity costs of time, and hence are more likely to find it worth their time and energy to redeem their CRV.



Interestingly, the wealth levels of those who recycle at handling fee versus processing fee centers are quite similar, implying that handling fee centers may not be much more convenient for low-income households, which was their intended purpose. This may be because of the inconvenient hours of handling fee centers mentioned above or due to the fact that some handling fee centers do not disburse CRV in cash but rather as a voucher to be redeemed for cash in the supermarket, which imposes additional transaction costs.

Additionally, we may want to consider individuals who report throwing recycling-eligible containers into the trash. Only around 8% of respondents reported throwing CRV containers into the trash in the past week rather than recycling them. (This low rate may be due in part to desirability bias – where individuals do not want to look unfavorable to the researchers conducting the survey and hence underreport behaviors with a negative connotation.) We may wonder if trash behaviors are simply because individuals are unaware of the possibility of CRV redemption. Yet, only around 15% of respondents who threw containers in the trash (i.e., 15% of that 8%) said they were unaware of how to redeem containers for CRV. Hence, these individuals probably for the most part do not find their current recycling options sufficiently convenient.

Finally, we consider the behavior of diverters, or “scavengers,” who redeem CRV containers that they did not purchase. Diverters are generally low-income individuals (making <\$10,000 a year) who use these CRV returns as a primary source of income. While individuals in our survey do not formally identify themselves as diverters, we identify the 16% of recycling center users who visit centers very frequently as likely diverters. Notably, most individuals who return materials that are not their own report that these materials came from the trash (about 73% of total recycled containers), suggesting that diversion behavior may increase overall recycling, while also serving as an income source for very poor individuals.

### ***3.8 Change in Convenience Over Time***

Generally, our survey data suggest limited changes in the convenience in California recycling over time. About 12% of AmeriSpeak respondents said recycling this year was easier than last year and 9% said it was harder, but 66% said they had experienced no change (others were unsure). Additionally, we may wonder if it has become easier or harder to redeem CRV payments over time. One way to look at this is to consider changes in distance to the nearest recycling center over time. In agreement with the survey evidence, the average distance to a recycling center hardly changed between 2006 and 2017. The average distance from the center of each zip code in the state to the nearest recycling center was 2.76 miles in 2006 and 2.73 miles in 2017 (Berck et al., 2021).

### 3.9 *Survey Insights*

In general, consumers seem to find recycling centers convenient when they are close to home, open at good times, and have short lines. Recycling centers generally seem to meet this definition for typical users, who tend to be poorer and less educated. Those who do not choose to recycle at centers tend to be more affluent and hence may not find recycling at centers worth their time, given a higher opportunity cost of time, and instead choose to recycle through curbside collections and at businesses. Because policymakers were most concerned about providing CRV redemption opportunities to lower-income consumers, for whom this payment is significantly more important under the deposit-refund system, we may consider this a successful policy, especially since so few people throw redeemable containers in the trash under this policy regime. Additionally, though the CRV increases potentially inefficient diversion behavior, our survey evidence suggests that this behavior is mostly “good” diversion in the sense that it increases the overall number of containers recycled.

## 4 Willingness To Pay for Recycling Options

In Berck et al. (2020), we formalize some of the observations published in Berck et al. (2021) using econometric analysis to estimate consumers’ willingness to pay to recycle via various methods. This allows us to quantify the importance to consumers of various attributes of different recycling methods. Moreover, this exercise allows us to model and predict consumer behavior under various policy change scenarios that are key to efficiently implementing California’s deposit-refund program. We can also look at behavior changes for various demographic groups, allowing us to understand heterogeneous effects of such policy shifts.

We consider two types of potential policy changes: adjustments to the CRV value and the closure of handling fee recycling centers.

First, we want to understand whether an increase in the CRV amount would increase the overall recycling rate, simply induce switching between recycling methods, or have no effect at all. The answer is not clear *ex ante*, as those who currently recycle but do not redeem their CRV (for instance, through curbside recycling) or those who use trash disposal may or may not be sensitive to small changes in the CRV amount.

Second, we consider the effect of reducing or eliminating the state’s subsidy for handling fee centers. A 2008 policy change that reduced handling fee payments for some centers caused many of these centers to close. In addition, many recycling centers throughout California have closed in response to China’s 2017 decision to restrict imports of recyclable materials, further limiting recycling center options for consumers. This has affected all recycling centers, not just handling fee centers, but has further reduced the ability of handling fee centers to operate without a state subsidy. It is costly for the state to pay to keep the remaining handling fee centers open, and they likely would not exist otherwise. Given CalRecycle’s goal

of convenient recycling for all, it is important to understand whether the closure of handling fee centers limits CRV recycling opportunities for consumers and whether the state should change its policies regarding handling fee payments.

#### ***4.1 Modeling Framework***

To estimate consumer willingness to pay for various recycling methods, we use data from the AmeriSpeak survey described in the previous section, which is representative of California consumers. We use data on reported recycling behavior of survey respondents to estimate a discrete choice model of their preferences for the disposal options available to them (including processing fee recycling centers, handling fee recycling centers, curbside recycling pickup, recycling at other establishments, and trash), using mixed logit and random coefficient logit specifications. Choices in our model are defined as a bundle of attributes, including the ability to redeem CRV, disposal time and effort, proximity to home, and location in a convenience zone.

The “distance to center” parameter is used as the “price” variable traditionally needed to run a logit specification and is calculated by measuring the distance from a respondent’s zip code centroid to the closest recycling fee center; we adjust this variable downward for respondents who report that they collect containers over a long period and then visit a center, as this is presumably associated with lower travel costs than frequent center visits. Additionally, this model allows us to calculate some individual-specific utility parameters regarding certain attributes, allowing for heterogeneity in the population to partially explain willingness to pay. Demographic attributes considered include income, age, race, education, and quantity of CRV-eligible containers purchased. Hence, we are able to model a consumer’s choice to use a given disposal method as a function of the attributes of various recycling methods and demographic information collected from the AmeriSpeak survey and to estimate the various logit specifications using maximum likelihood estimation.

#### ***4.2 Consumer Valuation of Recycling Method Attributes***

Using our preferred model specifications, we note that consumers have a significantly negative valuation of distance, meaning they generally prefer disposal options with less travel involved. We also see that consumers have a strongly positive valuation of being able to receive a CRV payment. Surprisingly, consumers seem to have a preference for processing fee centers over handling fee centers, though the negative effect of being a handling fee center is rather small in magnitude. This may be because some handling fee centers disburse CRV payments as vouchers to be redeemed in their associated grocery stores, adding additional transaction costs for consumers. Finally, consumers also place a premium on recycling more generally,

including through non-center pathways, where CRV is not redeemed. Hence, it seems consumers get some utility solely from the act of recycling (as compared to trash disposal). This is perhaps due to the “warm-glow utility” associated with taking a more environmentally friendly action. Additionally, we see that some individuals tend to prefer recycling at centers as opposed to trash disposal; notably, this is the case for those who purchase more CRV eligible containers, non-white individuals, and less-educated individuals.

### ***4.3 Changes in CRV Policy: Stated Preference Elicitation***

Before looking at the results of our model’s simulation of how consumer container disposal behavior changes with the CRV amount, we look at individuals’ reported recycling behavior predictions under various CRV amount changes. Specifically, respondents in the AmeriSpeak survey were asked if they would recycle at a center under a randomly presented CRV value of one of the following: 7, 10, 15, 20, or 40 cents. Results can be seen in Table 1.

As expected, the number of people who said they would redeem their containers at a recycling center increases with the CRV, regardless of their current recycling method. However, it is more important to know whether an increase in the CRV would encourage individuals who are currently using trash disposal to recycle, rather than just changing their recycling method from curbside to center recycling. We see in the bottom panel that, for those using trash for disposal, an increase to 7 cents leads to only 11% saying they would recycle at a center, while an increase to 10 cents would lead to 35% saying they would do so. For these individuals, it would require a fairly dramatic increase in the CRV (to at least 15 cents) before more than half say they would start taking containers to a recycling center. Hence, this data suggests that small changes in the CRV amount would likely not lead to great increases in the recycling rate. Because only 8% of AmeriSpeak respondents reported throwing containers in the trash, an increase in the CRV to 7 cents would result in only a 1% increase in container recycling, while an increase to 10 cents would result in a 2.7% increase (Berck et al. 2018). For a more specific example: the 2016 recycled share of PET (one type of plastic often used in beverage containers) was 76%. The recycled share would merely go from 76% to 78% with a 7 cent CRV.

Notably, the survey respondents who use curbside were much more responsive to a potential increase in CRV than those who threw containers in the trash. Of people who said that they were currently using curbside bins to recycle their beverage containers, at a CRV of 7 cents, 34% said they would recycle at a center; at a CRV of 10 cents, 41% said they would do so. Yet, similarly to those disposing of containers in the trash, an increase in the CRV to 15 cents was necessary before more than half would start taking containers to a recycling center. Hence, a policy to increase the CRV should carefully weigh the gains of inducing slightly more people to recycle against the increased program costs (and perhaps increased wait times) of having more individuals who were already recycling bringing their containers to centers.

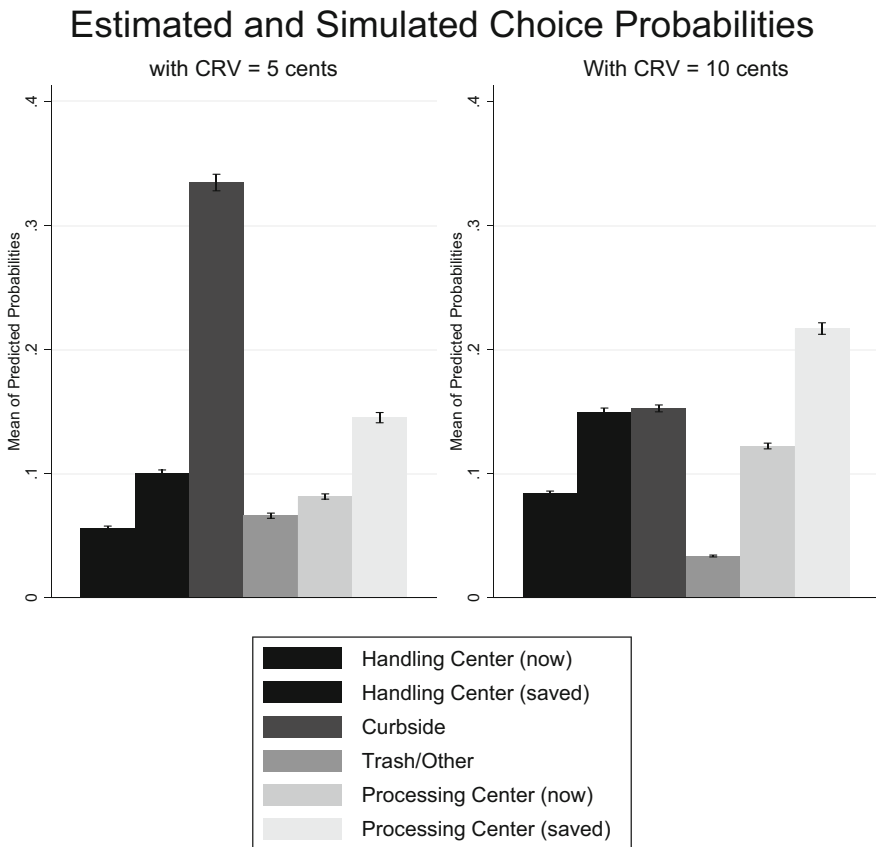
**Table 1** Hypothetical recycling behavior under different CRV regimes (Berek et al., 2020)

	7 cents	10 cents	15 cents	20 cents	40 cents	Total
<i>All survey respondents</i>						
Yes	0.66 (0.05)	0.71 (0.04)	0.83 (0.03)	0.86 (0.03)	0.89 (0.03)	0.79 (0.02)
No	0.34 (0.05)	0.29 (0.04)	0.17 (0.03)	0.14 (0.03)	0.11 (0.03)	0.21 (0.02)
Total	173	210	164	164	182	893
<i>Current curbside recyclers</i>						
Yes	0.34 (0.11)	0.41 (0.07)	0.68 (0.07)	0.75 (0.08)	0.86 (0.05)	0.58 (0.04)
No	0.66 (0.11)	0.59 (0.07)	0.32 (0.07)	0.25 (0.08)	0.14 (0.05)	0.42 (0.04)
Total	53	71	53	53	54	284
<i>Currently disposes via trash</i>						
Yes	0.11 (0.08)	0.35 (0.14)	0.75 (0.11)	0.83 (0.10)	0.82 (0.08)	0.68 (0.06)
No	0.89 (0.08)	0.65 (0.14)	0.25 (0.11)	0.17 (0.10)	0.18 (0.08)	0.32 (0.06)
Total	10	15	21	21	20	87

Note: Standard errors are in parentheses. Each weighted respondent was assigned randomly to one of the five changes in CRV value, and were asked whether or not they would change their recycling behavior under the change

### 4.4 Changes in CRV Policy: Model Simulation Results

Stated elicitation of hypothetical behaviors via survey tends to be biased, as individuals often overestimate their positive behaviors (like recycling) compared to reality. Hence, it is important to verify the results of a positive relationship between CRV level and recycling rates with our estimated model. We do this by fitting the values of individual behavior with our estimated model parameters and inserting our changed value of CRV. Specifically, we test the effects of an increase in CRV from 5 to 10 cents. The results are displayed in Fig. 3. Note that columns marked “saved” denote individuals who save up containers for a long period of time before recycling them at a center.



Based on Mixed Logit Choice specification for all alternatives, although only the choices of a single disposal method are shown here

Fig. 3 Simulated increase in the CRV. (Berck et al. 2020)

Similar to what we saw in the stated preference data, we see that most of the shift in recycling center use under the 10 cent CRV scenario comes from current curbside users. Yet, we also see some consumers switching from trash disposal to recycling at a center, slightly increasing the overall percentage of recyclers. It is also important to note that these “marginal recyclers” who switch to recycling at a center under a 10 cent CRV are mostly current curbside recyclers (who tend to be wealthier and white on average); thus, the individuals who would benefit most from this policy change would be mainly white, wealthier, and more educated individuals. Hence, the welfare gains for poor individuals are relatively minimal under this policy scenario.

#### ***4.5 Changes in the Number of Recycling Centers: Model Simulation Results***

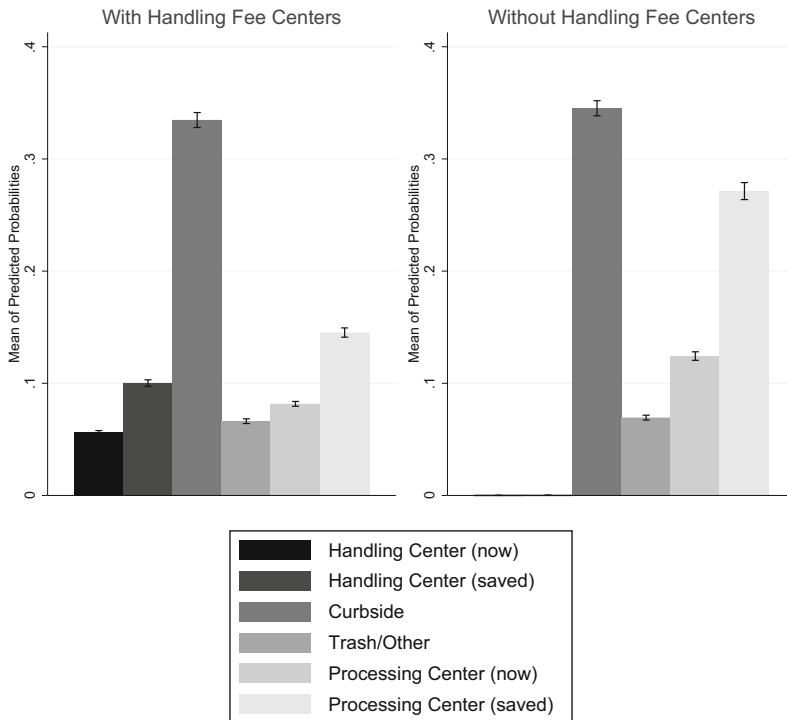
Next, we look at the changes in recycling behavior under a scenario where all handling centers are closed. We do this by recalculating the distance to the closest recycling center (which would be greater for many individuals under this scenario) and by removing the “handling fee center” attribute from the model. We can see the results in Fig. 4 below.

Notably, the overall percentage of recyclers is essentially unchanged when all handling fee centers are closed. Instead, we mostly see handling fee center users switching to recycling at processing fee centers. While these centers may be slightly farther away on average, we also saw in our estimation that consumers slightly preferred using processing fee centers to handling fee centers. Hence, the changes in consumer surplus associated with this policy change are extremely minimal. Therefore, mandating that supermarkets have associated handling fee centers, and subsidizing such centers, is not particularly key to ensuring convenience in CRV redemption for consumers.

#### ***4.6 Takeaways From Discrete Choice Model***

Through estimation of a discrete choice model where consumers have various options for beverage disposal, we calculate empirically that consumers prefer recycling options that do not involve extensive travel, provide CRV payments, and are at processing fee (rather than handling fee) centers. This more formally echoes the results of Sect. 3. Using our model to estimate changes in CRV policy, we see that doubling the CRV amount would induce only a modest increase in overall recycling, and the benefits of this policy would mostly accrue to wealthier individuals. Hence, an increase in the CRV amount may not be the optimal policy to increase recycling. We also use our model to simulate the closure of handling fee centers and find that handling fee center users would generally just switch to

### Estimated and Simulated Choice Probabilities



Based on Mixed Logit Choice Specification for all combinations of alternatives, although only choices of a single disposal method are shown.

Fig. 4 Simulated closure of handling fee centers. (Berck et al., 2020)

using processing fee centers. Hence, the fear of consumers not having convenient recycling options without handling fee centers is likely unfounded.

## 5 Conclusion and Suggestions for Future Work

This chapter reviews evidence on whether the goals of the original California Bottle Bill and subsequent legislation are being met. We summarize empirical findings on how consumers define convenience in recycling opportunities, who recycles, and how. Our first takeaway is that recycling centers located within convenience zones are not considered to be especially convenient by recyclers, often due to limited operating hours and their frequent use of vouchers (rather than cash) to pay the deposit refund. These findings imply that the definition of convenient recycling should be recycling at centers that are nearby, open during convenient hours, and have short lines. Moreover, if increased convenience is required, the



requirement for open hours for handling fee centers could be changed to better match shopping hours. This change would likely increase handling fee centers' collection of recyclable material and increase consumer convenience. However, one must recognize that handling fee centers could have already extended their hours. The fact that they have not means that they or their host supermarkets do not consider extended hours to be economically desirable.

While the CRV is inducing people to recycle, the empirical evidence suggests that an increase in the CRV would not lead to major increases in recycling, due to the small number of containers that enter trash streams. In fact, diverters or "scavengers" retrieve and recycle a portion of containers that are thrown in the trash. This is a significant income source for diverters, who generally have very low incomes (median < \$10,000). Any policy changes aimed at reducing diversion would impact those residents. The fact that most diversion comes from trash streams, rather than from recycling bins, suggests that they may be operating in line with the overall goals of the recycling program.

Further work is needed to evaluate the effects of the 2008 legislation (which reduced handling fee payments for some centers) on California's recycling goals. As noted, smaller handling fee centers did not prosper under that legislation. However, keeping small handling fee recycling centers open would be very costly to the state of California. While the decrease in the number of centers may negatively impact consumers by decreasing recycling opportunities, the survey evidence showed that 93% of consumers drive to recycling centers. Once in the car, an additional distance of a mile or so is not expected to greatly influence consumer behavior.

**BERCKonomics** "Bonding over Environment, Resources, Coffee, and Kindness." A tribute to Peter: a scholar to look up to, a friend we miss, a role model to emulate, a gentle, funny, and kind man.

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