

THE HIERARCHY AND PERFORMANCE OF STATE RECYCLING AND DEPOSIT LAWS

Caroline Cecot & W. Kip Viscusi***

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INTRODUCTION

Motivated by a desire to reduce the amount of waste that ends up in landfills, exploit the potential usefulness of waste products, and avoid wasteful use of natural resources, most states have enacted some type of law to promote recycling behavior.¹ In many instances, these efforts take the form of general recycling laws, which either announce a commitment to promote recycling or establish recycling policy requirements that municipalities must meet. Sometimes these efforts impose fees on beverages sold in containers made of glass, plastic, and cans that are refunded when the containers are returned to recycling centers. The adoption of such laws and their requirements vary across states.

The substantial, but incomplete, coverage of these efforts raises interesting policy questions and provides an opportunity to compare the recycling performance in states with and without such laws. First, are all such

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* Assistant Professor of Law, Antonin Scalia Law School, George Mason University.

** University Distinguished Professor of Law, Economics, and Management, Vanderbilt Law School.

1. See Jennifer Schultz & Kristen Hildreth, *State and Federal Efforts to Revitalize Recycling*, 28 LEGISBRIEF NO. 41, (2020) (discussing efforts that state and federal organizations have taken to revitalize recycling and their reasons for doing so).

laws equivalent in form or impact? For example, there could be a standardized recycling law template that all states have chosen to adopt. The type of recycling laws states enact may not matter if all such laws have comparable effects on recycling once the state has announced an avowed interest in promoting recycling. This article's review of these laws finds that recycling laws vary considerably across states in terms of their overall structure and their impact on recycling rates. Second, because there is heterogeneity in the legal approaches, we developed an approach for characterizing the nature of the differences and established a meaningful hierarchy of the degree of stringency of the laws. A principal difference in these laws is not the avowed interest in promoting recycling but rather the degree to which the laws establish concrete mechanisms for promoting recycling. Third, we explore whether there is any evidence that these laws make a difference in increasing household recycling behavior and whether the differences depend, in part, on the form of the recycling law that is introduced. In addition to exploring general recycling laws, we also examine the role of deposit policies, which are separate and more narrowly focused because they are restricted to the types of materials that are covered.

Part II focuses on several different types of recycling laws. While there is substantial heterogeneity in these laws, it is possible to establish a general hierarchy. The more stringent laws usually also include components that can be found in the less stringent interventions. For example, weak recycling laws specify that recycling is a goal, but do not include any requirements that municipalities must meet to promote this goal. Meanwhile, more stringent laws go beyond aspirational expressions of intent by including other components that will foster concrete measures to promote recycling. The ranking of the laws, in terms of their apparent stringency, should ideally influence the extent to which the laws promote recycling behavior. More comprehensive laws, with additional provisions to implement a vigorous recycling effort, should result in a greater impact on the rate of recycling. Using a national dataset of over 400,000 observations of household recycling decisions, we present new recycling rate statistics to explore the extent to which enacting laws of different stringency has led to different rates of recycling across states.²

Some states have enacted laws that focus on particular products by establishing deposit policies (primarily for glass, plastic, or aluminum beverage containers) instead of addressing recycling in general terms. Part III explores the breadth and impact of deposit policies. Although states differ in terms of their coverage and the deposit amount, these policies are less

2. The dataset is the Knowledge Networks survey data. It is not publicly available but is a proprietary dataset made available to the authors.

nuanced in terms of the nature of their policy intervention than are recycling laws. It is also feasible to compare the recycling rates for each of the products covered by deposit policies to assess whether recycling rates for those products vary depending on whether the state has enacted a deposit policy.

The average statistics provide a nice summary perspective on the average effects of recycling laws. But are these differences attributable to other influences in the states with the recycling and deposit laws, such as different demographic compositions of the state and different environmental preferences of the citizenry? Part IV summarizes several studies that have found substantial differences across legal regimes that continue to be evident even after controlling for these factors.

The concluding Part V finds that neither recycling laws nor deposit policies are entirely symbolic. Each of these laws provides a mechanism for promoting higher rates of recycling. It is particularly striking that increasing the level of stringency of recycling laws is associated with higher recycling rates. Deposit policies are also highly effective. There is strong evidence that the intent of these efforts, coupled with mechanisms to achieve the recycling objectives, have been born out in household recycling behavior. The widespread engagement in recycling efforts establishes a recycling norm that has the additional dividend of promoting pro-environmental attitudes more generally.

I. STATEWIDE RECYCLING LAWS

A relatively broad legal effort to promote recycling consists of recycling laws, which may include many different components and vary across states in their structures. When states contemplate enacting such a law, they should question which components of the law appear to be most consequential in their impact on recycling behaviors. To examine these differences, we identified all statewide general recycling laws and classified them in terms of a hierarchy pertaining to their level of stringency. The focus here is on policies and laws in place during the 2005–2014 period which will be analyzed empirically below.

In our categorization of statewide recycling requirements, 15 states have not enacted any broadly based recycling law.³ However, this does not mean that these states have no other relevant state laws or local initiatives. For example, two of these states, Massachusetts and Vermont, have enacted deposit policies. These deposit policies provide financial incentives for recycling covered beverage containers and have a targeted impact on

3. See W. Kip Viscusi et al., *Lessons from Ten Years of Household Recycling in the United States*, 48 ENV'T L. REP. 10377, 10379 (2018) (listing non-enacting states as: AK, CO, DE, GA, ID, IN, KS, KY, MA, MO, ND, OK, UT, VT, and WY).

recycling behavior, as we discuss in Part III.⁴ And both Massachusetts and Vermont have notable recycling initiatives at the local level. In Massachusetts, the City of Cambridge requires all households, businesses, and apartments to recycle glass beverage and food containers; metal beverage and food containers; plastic bottles; paper; and a broad range of other products such as cardboard and yard waste.⁵ In Vermont, Chittenden County (which includes Burlington) requires households, businesses, and apartments to recycle glass; food and beverage bottles and jars; aluminum and steel cans as well as aluminum foil; and mixed paper and cardboard.⁶

Other states—without either statewide recycling laws or deposit policies—may also have vigorous local recycling initiatives that can serve as a substitute for statewide laws. In Colorado, the City of Boulder has enacted “the [C]ity’s Universal Zero Waste Ordinance that requires all businesses, apartments, and homes to have recycling and composting collection services.”⁷ Not surprisingly, Boulder has the highest recycling rate across all businesses and households in the state.⁸ If the focus is only on residential rates, then the City of Loveland has the highest recycling rates in Colorado.⁹ Loveland has a nationally recognized model that prices trash on a volume-adjusted basis, which “creates a strong financial incentive for households to recycle more and produce less waste.”¹⁰ Although there is no statewide norm for curbside recycling, most cities in Colorado require their residents to opt into a curbside recycling approach.¹¹ Some waste collection services that

4. MASS. GEN. LAWS ANN. ch. 94, §§ 321–27; VT. STAT. ANN. tit. 10, §§ 1521–30 (1971). Additionally, Vermont adopted another statewide recycling measure in 2012, the Vermont Universal Recycling Law, which banned food scraps from disposal to avoid food waste in landfills and to support composting. However, the law was not implemented until 2014. Because this study analyzes data up until May 2014, we classify Vermont as not having a state recycling law for the four products of interest in our analysis. VT. STAT. ANN. tit. 10, § 6602 (2012); See Yerina Mugica, *Food to the Rescue: Vermont’s Universal Recycling Law*, NAT. RES. DEF. COUNS. (Oct. 24, 2017), <https://www.nrdc.org/resources/vermonts-universal-recycling-law> (discussing the Vermont recycling law and its effects on food waste).

5. *Mandatory Recycling: Cambridge, Massachusetts, USA*, ECO-CYCLE, <https://www.ecocyclesolutionshub.org/location/mandatory-recycling-cambridge-massachusetts-usa/> (last visited Oct. 1, 2021).

6. *Mandatory Recycling: Chittenden County, Vermont, USA*, ECO-CYCLE, <https://www.ecocyclesolutionshub.org/location/mandatory-recycling-chittenden-county-vermont-usa/> (last visited Apr. 18, 2022).

7. RACHEL SETZKE ET AL., ECO-CYCLE & COPRIG FOUND., *THE STATE OF RECYCLING & COMPOSTING IN COLORADO*, 17 (4th ed. 2020).

8. *Id.*

9. *Id.* at 18.

10. *Id.*

11. *Id.* at 19.

serve more rural Colorado counties may also offer recycling as part of their waste collection services.¹²

For the states that have enacted statewide recycling laws, we have developed the following order of the recycling law components: recycling goals, recycling plans, recycling opportunities, and mandatory recycling. We refer to this order as a hierarchy because more stringent measures usually include the less stringent components as well.

Laws that we characterize as only specifying a recycling goal are strictly aspirational, as they are limited to advocating a recycling goal. The goal laws do not include any concrete policy mechanism that will assist in meeting that goal. In our categorization of statewide recycling requirements, six states have recycling goals but have not specified more ambitious recycling actions to implement efforts to attain these goals.¹³ Indicating that recycling is a laudatory objective and asserting that the state seeks to meet a particular percentage recycling goal is the first level of policy intervention.

The level of the specified waste reduction goal differs across the states that have enacted goals. Louisiana specifies a goal amount of 25%; Mississippi specifies a waste reduction amount of 25%; Montana specifies a goal amount of 17%; New Hampshire has a waste reduction goal of 40%; Rhode Island has a 35% goal for recycling waste and 50% for recycling beverage containers; and South Dakota has a 50% goal for waste reduction.¹⁴ Indicating specific environmental goals is not unique to recycling. The United States and other countries have also announced quantitative goals with respect to reducing carbon emissions to reduce global warming.¹⁵ But in the absence of also committing to mechanisms to advance the goals that have been set, such statements regarding recycling goals are unlikely to be consequential. Economists sometimes refer to pronouncements for which there is no cost to making the assertion as “cheap talk.”¹⁶ When there is no

12. See *Services*, TWINENVIRO SERVS., <https://twinenviro.com> (last visited May 2, 2022) (describing how Twin Enviro Services provides for garbage pickup for both waste disposal and recycling in Routt County, Moffat County, Fremont County, and Las Animas County).

13. See *infra* Table A4 (listing the states laws that only have a recycling or waste reduction goal).

14. LA. STAT. ANN. §30:2413(B) (2003); MISS. CODE ANN. § 17-17-221(2)(d) (2022); MONT. CODE ANN. § 75-10-803(2)(a) (2021); N.H. REV. STAT. ANN. § 149-M:2(1) (2019); R.I. GEN. LAWS §§ 23-18.8-2(3), 18.12-3(a)(1) (2022); S.D. CODIFIED LAWS § 34A-6-60 (2022); See *infra* Table A4 (listing the states laws that only have a recycling or waste reduction goal).

15. See, e.g., *Appendix I – Quantified Economy-Wide Emissions Targets for 2020*, U.N. CLIMATE CHANGE, <https://unfccc.int/process/conferences/pastconferences/copenhagen-climate-change-conference-december-2009/statements-and-resources/appendix-i-quantified-economy-wide-emissions-targets-for-2020> (last visited May 2, 2022) (detailing the goals that each country made in 2020).

16. See, e.g., Joseph Farrell & Matthew Rabin, *Cheap Talk*, 10 J. ECON. PERSPS. 103, 104 (discussing “cheap talk” as communication that imposes no costs on the sender if the information conveyed is inaccurate).

cost to the party making such claims, there is no assurance that the claims will be borne out.¹⁷

The second level of stringency consists of laws that require municipalities to develop a plan for meeting recycling goals. In this way, these laws go further than simply promoting recycling as a goal. A recycling law mandating the development of a recycling plan is the most common form of recycling law—15 states have recycling plan laws.¹⁸ These laws impose local planning requirements on counties and municipalities to evaluate their current recycling programs and to develop plans for more comprehensive future programs.¹⁹ Except for Michigan and Ohio, the recycling laws in all states that require regional waste management plans—including recycling considerations—also specify a recycling or waste reduction goal.²⁰ The specified goal amounts in these recycling plan states range from 2 to 25% (AL, IL, TN) and others have a range up to 50% (CA, HI, IA, ME, NE).²¹

The third level of stringency consists of laws that require that municipalities implement policies to take the recycling effort beyond plans and to provide recycling opportunities for households to engage in recycling. In our categorization of statewide recycling requirements, eight states have recycling opportunity laws (AZ, AR, FL, MN, NV, OR, SC, WA).²² Except for Arizona, all states with recycling opportunity laws also specify a recycling goal: 25% (NV), 30% (FL), 35% (MN, SC), 40% (AK), and 50% (OR, WA).²³ Although the wording of opportunity laws differ by state, the general spirit is captured by the Oregon law provisions:

[T]he ‘opportunity to recycle’ means at least that the city, county or metropolitan service district . . . [p]rovides a place for collecting source separated recyclable material . . . located either at a disposal site or at another location more convenient to the population being

17. *Id.* at 107 (“It is consistent with common knowledge of rationality, and with equilibrium, for cheap talk to be completely ignored.”).

18. These states are as follows: AL, CA, HI, IL, IA, ME, MD, MI, NE, NM, NC, OH, TN, TX, VA. See *infra* Table A3.

19. See *infra* Table A3 (listing states requiring waste management plans with recycling considerations); see also CAL. PUB. RES. CODE § 41821(a)(1) (2021) (requiring most jurisdictions to “submit a report to the department summarizing the jurisdiction’s progress in reducing solid waste.”).

20. See *infra* Table A3 (showing all the states with regional waste management plan requirements that also have specified goals); ALA. Code §22-27-45(4)(a)(3) (1975); 415 ILL. COMP. STAT. ANN. 15/4; TENN. CODE ANN. § 68-211-813; VA. CODE ANN. § 10.1-1411; TEX. HEALTH & SAFETY CODE ANN. § 363.062; CAL. PUB. RES. CODE § 41821; HAW. REV. STAT. § 342G-26; IOWA CODE ANN. § 455B.306; ME. REV. STAT. ANN. TIT. 38, §§2132.1., 2133.1-1-A (WEST 2019); Neb. Rev. Stat. § § 13-2031–2032; N.M.S.A. 1978, § § 74-9-4-7 (LexisNexis 2022).

21. See *infra* Table A3.

22. See state statutes *infra* Table A2 (listing states with opportunity recycling laws).

23. NEV. REV. STAT. ANN. § 444A.040; FLA. STAT. § 403.706; MINN. STAT. § 115A.551(for a county outside of the metropolitan area); S.C. CODE ANN. § 44-96-50; ARK. CODE ANN. § 8-6-720; OR. REV. STAT. §§459A.010(1)(b) (2014); WASH. REV. CODE ANN. § 70.95.090.

served and, if a city has a population of 4,000 or more, collection at least once a month of source separated recyclable material . . . from collection service customers within the city's urban growth boundary.²⁴

The final level of stringency consists of laws that impose mandatory recycling behavior. These mandates require people to separate their recyclable products from other household waste and recycle those products appropriately. Households need the opportunity to engage in this recycling behavior; this activity should be subsumed in laws making recycling mandatory. In our categorization of statewide recycling requirements, six states and the District of Columbia have mandatory recycling laws.²⁵ All except for two of the states (PA, WI) that impose mandatory recycling requirements also specify recycling goals. The recycling goals vary across the following ranges: 25% (CT), 45% (DC, NY), 50% (WV), and 60% (NJ).²⁶ The wording of the Connecticut mandatory recycling law is representative of the stipulations in other mandatory recycling laws:

The Commissioner of Environmental Protection shall adopt regulations . . . designating items that are required to be recycled . . . Each person who generates solid waste from residential property shall . . . separate from other solid waste the items designated for recycling pursuant to subsection (a) of this section.²⁷

Figure 1 illustrates the geographical distribution of the different types of recycling laws, the details of which are summarized in the Appendix tables. The colors of the states indicate different types of recycling laws. Many states in the middle of the country have no recycling laws, and these states are joined by two New England states. The states in green have mandatory recycling laws. This group of states includes Wisconsin and a contiguous cluster of states from West Virginia to Connecticut. The states with opportunity laws are colored in blue and include a continuous set of Pacific states (excluding California) as well as four other states, the most populous of which is Florida. States with plan laws are highlighted in orange. These laws are the most frequent and many highly populated states, including California and Texas, have adopted them. The goal law states are highlighted

24. OR. REV. STAT. §459A.005 (2021).

25. The six states are as follows: CT, DC, NJ, NY, PA, WV, WI. *See infra* Table A1.

26. CONN. GEN. STAT. § 22A-241B (2021); D.C. CODE § 8-1007; N.Y. PUB. HEALTH & SAFETY LAW § 120-AA (McKINNEY 2014); W. VA. CODE ANN. § 22-15A-16; N.J. STAT. ANN 13:1E-99.16 (West 2009).

27. CONN. GEN. STAT. § 22A-241B (2021).

in yellow. They tend to be more remote and rural, where recycling may be more difficult due to lower population density.²⁸ States with no shading have not enacted any general recycling laws during the sample period that is examined below.

To investigate the impact of recycling laws on recycling behavior, we present new statistical results drawing on a national sample of household recycling behavior. The sample we are using is the Knowledge Networks Panel from 2005 to 2014, a national web-based panel of 171,296 households.²⁹ Unlike convenience samples like Amazon Mechanical Turk, Knowledge Networks (KN) recruited the sample based on a probability sample of the U.S. population.³⁰ Households that did not have computers or internet access were provided with this capability to promote a representative sample.³¹ One of the authors of this article used subsets of this panel for a series of studies undertaken for the U.S. Environmental Protection Agency.³² The panel dataset used here is based on the basic interview administered to all panel members, rather than a subsample that was given a special survey dealing with recycling.³³ The basic interview included a set of recycling questions inquiring whether households recycled each of the following products in the past year: paper, cans, glass, and plastic.³⁴ The wording of the questions was as follows:

Paper: “In the past 12 months, have you recycled your newspapers or other papers?”

Cans: “In the past 12 months, have you recycled your cans?”

Glass: “In the past 12 months, have you recycled your glass?”

Plastic: “In the past 12 months, have you recycled your plastic?”³⁵

These questions elicit the respondent’s stated recycling behavior, but do not ascertain the amount of each material that was recycled. Does the stated

28. Phil Burgert, *Recycling Programs Evolve in Rural Settings*, WASTE 360 (Nov. 1, 1993), https://www.waste360.com/mag/waste_recycling_programs_evolve.

29. GfK (Growth from Knowledge) subsequently bought Knowledge Networks. We refer to the panel as the Knowledge Networks Panel and to the company as Knowledge Networks (KN). Further information on the current panel is at <https://www.ipsos.com/en-us/solutions/public-affairs/knowledgepanel>.

30. See W. Kip Viscusi et al., *Discontinuous Behavioral Responses to Recycling Laws and Plastic Water Bottle Deposits*, 15 AM. L. & ECON. REV. 110, 117–18 (2013) (detailing the research method) [hereinafter *Discontinuous Behavioral Responses*].

31. *Id.* at 117.

32. *Id.*

33. See *id.* at 118 (noting the different surveys conducted by KN).

34. See Jason Bell et al., *Fostering Recycling Participation in Wisconsin Households through Single-Stream Programs*, 93 LAND ECON. 481, 483 (2017) (listing four yes or no recycling questions for households).

35. *Id.*

recycling behavior of whether the household recycled any of the materials in the past year correspond to the amount of material the household recycled? Answering this question is possible if one can obtain data on the tonnage of recycling material and explore how it corresponds to the stated recycling effort. For a subset of the KN data, it was feasible to analyze the relationship between the recycling question responses and the tonnage of material recycled in different Wisconsin counties. On average, for every 10% increase in stated recycling behavior, we found an 8% increase in the volume of recycling.³⁶ This relationship indicates that boosting the rate at which people report recycling materials in the survey is strongly correlated with actual differences in the tonnage of material recycled. Increasing the stated percentage of respondents who recycle is correlated with an increased volume of recycling but at a bit less than a one-for-one percentage basis.

The Knowledge Networks Panel includes 171,296 households.³⁷ Because many households were interviewed multiple times, there are 406,952 observations of recycling behavior. We present representative statistics for the first survey that the household completed (171,296 observations). We also present results across all surveys that the household completed (406,952 observations). Households sometimes completed more than one survey. To avoid counting the household more than once, we present representative statistics for the first survey that the household completed. We also present results across all the surveys that the household completed, which are quite similar. Because the results are similar in each case, subsequent figures utilize data from the entire sample rather than just the initial interview. As one might expect, the data gathered over a series of years tends to reflect somewhat greater levels of recycling behavior than is reported in the initial interview with the household. Recycling rates have tended to increase over time nationally so that some upward trend in recycling should be expected.³⁸ In addition, panel members who are interviewed multiple times may be more diligent recyclers; greater recycling behavior may also reflect their stability as members of the panel. Because households reported their state of residence, we were able to match their recycling answers with their state's recycling laws. This made it possible to examine how recycling behavior differs depending on the state recycling laws.

Figure 2A provides the results based on the full sample of observations, and Figure 2B presents the results for the household's first interview. In

36. *Id.* at 484.

37. The summary statistics reported in the remainder of this Part are from the dataset created by the authors using the Knowledge Networks Panel and the state recycling laws. This dataset is on file with the authors.

38. See Viscusi et al., *supra* note 3, at 10378 (reporting steadily rising recycling rates from 2005 to 2014).

Figure 2A, the full sample reported recycling 2.7 of the four materials on average, which is somewhat greater than the 2.5 average amount of materials recycled in Figure 2B. The recycling rates over the series of interviews for each household are very similar to the recycling rate reported in the household's initial interview. The overall recycling rates among the different categories of recycling laws are similar but somewhat higher in Figure 2B. Given the similarity and fact that recycling rates have generally increased over time, the rest of this article focuses on the full sample observations.

The recycling rates under the four different categories of laws follow the expected ordering. The recycling rate measure refers to the number of materials out of the four specified materials (glass, cans, plastic, and paper) that the household reported recycling in the past year. The rate does not imply that the household always recycled these materials because the question only addresses whether at some point in the past year the household recycled these materials. The greatest recycling rate out of the four possible materials is: 3.2 materials for households in mandatory law states; 2.9 materials for households in opportunity law states; 2.6 materials in states with plan laws; and 1.9 for states with goal laws. Interestingly, states with no recycling law have a recycling rate of 2.3, which exceeds the rate in the goal law states. This weak performance of goal laws may reflect the extent to which announcing a recycling goal without any practical steps for implementation is not an effective mechanism for increasing recycling. States without recycling laws may have higher recycling rates than states with goal laws because states without laws, like Colorado, have strong local recycling efforts. Also, Vermont and Massachusetts have deposit laws at the state level and local initiatives that encourage recycling behavior apart from the presence of any general recycling law during the sample period.

For all major categories of laws there has been a steady upward trend in the recycling rate. States with the more stringent laws had the highest baseline recycling rates. Consequently, these states displayed the most modest growth of recycling behavior over the 2005–2014 period. Over this period, the recycling rate in the mandatory recycling states increased from 65% to 67%. The recycling rate in the opportunity states increased from 54% to 60%. The recycling rate in the plan states increased from 42% to 50%. The largest gains (11%) were for goal law states and states with no recycling laws. These states increased recycling rates from 30% to 41%. The relatively small increases in states with stronger recycling laws are likely because there may be some ceiling effects that limit the opportunities for additional increases in recycling. The fact that recycling rates increased over time for every category raises the possibility that recycling may be becoming a national behavioral norm as not littering has become an established norm.

Recycling rates are greater in the states with more stringent recycling laws, but how is this level of recycling achieved? What recycling policy mechanisms tend to be engaged as a consequence of these laws? There are differences in the mechanisms that are implemented across states with different recycling laws. Table 1 shows results from a Knowledge Network (KN) 2009 sample survey with questions that inquire where the respondent undertook the recycling behavior: whether the household took the material to a community recycling center, whether the household used curbside recycling, or whether the bottles or cans were returned for deposit.³⁹

The curbside recycling statistics are most telling. In mandatory recycling law states, 76% of the households reported that they used curbside recycling. This percentage drops to 54% for opportunity law states, and 41% for plan law states. Strikingly, the provision of curbside recycling plummets to 11% for goal law states. Because this percentage is well below the 31% rate for the states that use curbside recycling without general statewide recycling laws, it is not surprising that the states without such laws perform better in terms of their recycling rates.

The principal alternative to curbside recycling is dropping off recyclable materials at a location such as a community center. These centers are most widely available in states with a recycling plan, as 26% of respondents reported the use of community centers in these areas. About 15%–17% of respondents in all other states use community centers. On average, one-fifth of the sample uses community centers for recycling.

II. DEPOSIT LAWS

A less popular but potentially effective approach to increasing recycling of specific products is the adoption of deposit laws. These laws impose fees on containers—typically beverage containers made of glass, plastic, or aluminum—that are refunded when the containers are returned to recycling centers.⁴⁰ There are ten states that have deposit laws for beverage containers.⁴¹ Figure 1 indicates these states using dots.⁴² Two states (NY, CT) with mandatory recycling laws also have deposit laws.⁴³ Only one state

39. The final option is to return the material to obtain a deposit refund. We discuss deposit laws in Part III. Only a minority of states with general recycling laws have such deposit policies so this pattern of returns is less instructive for our analysis of the effect of general recycling laws. In particular, the results show that there is generally not great reliance on returning bottles for deposit in the opportunity law states. Oregon is the only opportunity law state that has a deposit policy.

40. See, e.g., CAL. PUB. RES. CODE §§ 14500-99 (West 2021) (detailing California's deposit law fees); see *infra* Table A5 (listing all states with deposit laws).

41. See *infra* Table A5 (MI, CA, ME, OR, VT, HI, NY, IO, CT, MA).

42. See *infra* Figure 1.

43. Compare *infra* Table A1, with *infra* Table A5.

(OR) with an opportunity law also has a deposit law.⁴⁴ The greatest overlap between deposit laws and general recycling laws is with the plan law states (CA, IA MI, ME).⁴⁵ None of the goal law states have a deposit policy, while two of the states with no recycling laws (MA, VT) have a deposit law.⁴⁶

The coverage of these laws differs by state.⁴⁷ Deposits for beer and malt beverages are included in all states, as are deposits for carbonated soft drinks and mineral water.⁴⁸ States differ in some other aspects of the coverage. For example, some states also include deposits for wine coolers (IA, MI, ME, VT, CA, HI, NY).⁴⁹ With some exceptions, the amount of the deposit usually is five cents per container.⁵⁰ Michigan and Oregon (and California for bottles containing at least 24 ounces) have a 10¢ per container deposit, and others have different deposit amounts for wine and liquor (15¢ for beverages at least 50 mL in Maine and 15¢ for liquor in Vermont).⁵¹

The presence of a deposit fee imposes a financial cost on the customer if the container is not returned for the deposit refund.⁵² Consequently, deposit policies provide a financial incentive for returning the beverage containers. If the individual does not plan on returning the container for the deposit, the imposition of a deposit cost will raise the overall effective price of the beverage, which should decrease the demand for the product.⁵³

The presence of the deposit policy is related to the frequency of recycling of the products in the expected manner. Figure 3 reports the recycling rates for glass, which are 74% in the deposit states and 53% in the states without deposits. The overall recycling rate for glass is 59%. The recycling rates for plastic reported in Figure 4 are 81% in the deposit states and 63% in the non-deposit states. Figure 5 reports the recycling rates for cans, which are 84% in the deposit states and 71% in the non-deposit states. The final recyclable material covered in the survey is paper, reported in Figure 6. Even though paper products are not a target of beverage recycling efforts, the recycling rates in deposit states are 73% in the deposit states and 65% in the non-deposit states.

44. Compare *infra* Table A2, with *infra* Table A5.

45. Compare *infra* Table A3, with *infra* Table A5.

46. Compare *infra* Table A4, with *infra* Table A5.

47. *Redemption Rates and Other Features of 10 U.S. State Deposit Programs*, CONTAINER RECYCLING INST. (2021), https://www.bottlebill.org/images/PDF/BottleBill10states_Summary41321.pdf; see *infra* Table A5 (providing citations to the details of each deposit law).

48. See *infra* Table A5 (providing citations to the details of each deposit law).

49. *Id.*

50. *Id.*

51. *Id.*

52. See, e.g., PETER BOHM, *DEPOSIT-REFUND SYSTEMS: THEORY AND APPLICATIONS TO ENVIRONMENTAL, CONSERVATION, AND CONSUMER POLICY* 437 (1981) (describing a deposit-refund law as a combination of a tax and a subsidy).

53. *Id.*

The differences between the deposit and non-deposit states in recycling rates are instructive. As shown in Figure 7, the greatest boost in recycling rates in the deposit states as compared to the non-deposit states occurs for glass, for which there is a 21% difference between the deposit states and the non-deposit states. Glass containers are heavier than plastic and cans, which may require more effort to recycle. The deposit inducement may motivate that effort and be more consequential for products that impose greater effort costs to recycle. Deposits increase plastic recycling by 18%. The recycling of cans is 13% higher in the deposit states. The 8% boost to paper recycling may reflect a positive spillover effect that deposits have in encouraging people to engage in recycling more generally. Such an increase could occur if the presence of deposit policies led households to return the covered items to a recycling center where it was also possible to recycle paper. Another possible explanation is that establishing the norm that bottles and cans covered by deposits should be recycled may also lead households to believe that they should recycle paper. Figure 7 shows that the greatest boost in recycling rates occurs for glass in the deposit states as compared to the non-deposit states, for which there is a 21% difference.

III. IMPLICATIONS OF RELATED STUDIES

The overall differences in recycling rates between states suggest the potential influence of recycling and deposit laws. But there may be other characteristics of the households or aspects of these states that explain the differences. For example, if pro-environmental residents tend to congregate in the states with mandatory laws, those differences in household environmental attitudes may be responsible for the higher recycling rates in these states. A review of a multiple statistical analyses indicates that there is evidence that general recycling laws and deposit policies matter because they promote greater rates of recycling behavior. All the studies discussed below are regression analyses that include a variety of variables for household and regional characteristics.

Viscusi et al. (2011) analyzes the determinants of how many out of every 10 plastic water bottles the respondent has recycled in the past year.⁵⁴ The data analyzed consists of a subsample drawn from the 2009 KN survey and included 608 households that used bottled water.⁵⁵ In 2011, Viscusi et al. analyzed the determinants of how many out of every 10 plastic water bottles the respondent year.⁵⁶ States with deposit policies that do not cover water

54. W. Kip Viscusi et al., *Promoting Recycling: Private Values, Social Norms, and Economic Incentives*, 101 AM. ECON. REV. 65, 66 (2011) [hereinafter *Promoting Recycling*].

55. *Id.*

56. *Id.* at 68.

bottles also benefit from the deposit policy, as recycling rates out of every 10 plastic bottles purchased are 1.1 bottles higher.⁵⁷ General recycling laws also promote plastic water bottle recycling. Compared to states that have no recycling laws, the effect is a rate of 2.7 out of 10 water bottles for states that have a mandatory or opportunity law.⁵⁸ There is a positive, but somewhat smaller effect of 1.2 bottles out of 10 for states that have laws requiring a recycling plan.⁵⁹ In this sample, there is no statistically significant difference in recycling rates of plastic bottles between goal law states and states with no recycling laws.

The results reported in Viscusi et al. (2013) also focus on plastic bottle recycling but have a broader focus.⁶⁰ The empirical results similarly indicate that laws are consequential even after accounting for household and regional characteristics.⁶¹ Recycling rates vary with a variety of personal characteristics and are greater for self-described environmentalists, those with better education, higher incomes, and homeowners.⁶² The effect on the number of recycled plastic water bottles out of 10, due to the various laws, can be estimated by controlling for these and other potential influences. This analysis focused on a KN sample from 2008 and 2009 consisting of 5,213 survey participants, including 3,158 households that used bottled water.⁶³ The impact of deposit laws compared to non-deposit states increases recycling rates by 0.6 bottles out of 10 if the state has a deposit law and by 2.1 bottles out of 10 if the deposit law covers water bottles.⁶⁴ Compared to states with no recycling laws, the impact on recycling rates is 1.9 bottles out of 10 if the state has either mandatory recycling or a recycling opportunity law, 0.7 bottles out of 10 if the state has a recycling plan, and no statistically significant impact if the state has a recycling goal.⁶⁵

Households are also more likely to avail themselves of recycling amenities in states with vigorous recycling laws. In the sample used in Viscusi et al. (2013), deposit laws are not significantly correlated with the use of curbside recycling.⁶⁶ However, compared to states without any recycling law, households with mandatory recycling laws or recycling opportunity laws are 26% more likely to use curbside recycling, and in states

57. *Id.* at 67–68.

58. *Id.* at 68–69.

59. *Id.* at 68.

60. *Discontinuous Behavioral Responses*, *supra* note 30, at 110.

61. *Id.* at 139–140.

62. *Id.* at 129–130.

63. *Id.* at 117–118.

64. *Id.* at 126.

65. *Id.*

66. *Id.* at 134 (reporting statistically insignificant coefficients for deposit laws in regressions predicting curbside recycling).

with a recycling planning law curbside use is 7% greater.⁶⁷ Additionally, curbside recycling use for households in states with recycling goals does not differ significantly from states that lack any recycling law.⁶⁸ Deposit laws increase the probability of returning plastic water bottles to a recycling center or for deposit by 0.1, and deposit laws covering water bottles increase this probability by 0.2.⁶⁹

The Viscusi et al. (2013) article also examined the effect of including water bottles in the bottle deposit policy.⁷⁰ This change in policies occurred in 2009 for Oregon and Connecticut.⁷¹ For these states, it was possible to examine plastic water bottle recycling before and after the policy shift. After the policy shift to include plastic water bottle deposits, the percentage of recycling or returning these bottles increased in these states.⁷²

Using a larger set of KNs' data consisting of about 250,000 responses in 2006, 2009, and 2012, Viscusi et al. (2014) examined the effect of recycling and deposit laws on the average recycling rates on a county-wide basis.⁷³ The county averages considered were the average rates for glass, plastic, cans, and paper, as well as the overall county average recycling rate. The direction of the effects on recycling behavior are consistently similar in all instances.⁷⁴ For deposit laws, the comparison in the statistical analysis is the impact of deposit laws relative to the performance of states that have no deposit laws. Deposit laws, excluding deposits for water bottles, are associated with greater recycling rates, including higher recycling rates for paper—which is not covered by the deposit policies.⁷⁵ Deposit laws that exclude deposits for water bottles are associated with greater recycling rates for paper—which is not covered by the deposit policies.⁷⁶ Mandatory laws, opportunity laws, and plan laws all exhibit positive effects on counties' recycling rates compared to counties in states that have no recycling laws.⁷⁷ Meanwhile, the counties in states with recycling goals exhibit slightly lower recycling rates.⁷⁸

The presence of laws and deposit policies also may have a reinforcing effect on social norms with respect to the appropriateness of recycling behavior. To explore this mechanism, Huber et al. (2020) used two waves of

67. *Id.*

68. *Id.*

69. *Id.* at 136.

70. *Id.* at 137–39.

71. *Id.*

72. *Id.* at 138.

73. W. Kip Viscusi et al., *Private Recycling Values, Social Norms, and Legal Rules*, 124 REVUE D'ECONOMIE POLITIQUE 159, 163 (2014).

74. *Id.* at 166–68.

75. *Id.* at 166, 173.

76. *Id.*

77. *Id.* at 167, 173.

78. *Id.*

the Growth for Knowledge (GfK) Knowledge Panel, formerly known as Knowledge Networks.⁷⁹ The dataset consisted of 1,027 households in 2009 and 984 households in 2014.⁸⁰ The survey asked whether respondents would be personally upset if their neighbors failed to recycle. If respondents recycled all four materials (glass, plastic, cans, and paper) or if the average recycling rate in their county was high, they were more likely to be personally upset.⁸¹ Even after controlling for this influence (as well as personal characteristics such as whether the respondent is a self-described environmentalist), mandatory recycling laws have an additional positive effect on whether households would be personally upset if their neighbors failed to recycle.⁸² These results are consistent with the belief that laws and deposit policies that promote recycling rates help to establish recycling as a behavioral norm.

People who live in states with vigorous recycling laws and deposit policies may differ on their personal attitudes toward recycling, as compared with those in states without such requirements. Is there a more refined test to explore whether the positive relationship between recycling behavior and the various legal structures is an indication that the laws are instrumental in determining this behavior? The approach taken in Viscusi et al. (2020) examines people who move to a new recycling regime as a consequence of moving out of state.⁸³ Some moves may not change the recycling regime that people face. For example, a person could move from a mandatory recycling state to another mandatory recycling state. But there also are many households who may experience a change in their recycling legal environment. The sample analyzing these movers contained a subsample from the Knowledge Networks' GfK Panel consisting of 3,902 households that moved either out of their county or out of state.⁸⁴ For 2,404 of these households, the move was an in-state move, so there would be no change in the legal regime at the state level.⁸⁵ For the remaining 1,498 households, the move was out-of-state.⁸⁶ The within-state movers are still useful for comparative purposes. Moves are disruptive, so comparing the effect of out-

79. Joel Huber et al., *The Dynamic Relationships Between Social Norms and Pro-Environmental Behavior: Evidence from Household Recycling*, BEHAV. PUBL. POL'Y, Nov. 2017, at 1, 6.

80. *Id.* at 6.

81. *Id.* at 16.

82. *Id.*

83. W. Kip Viscusi et al., *Quasi-Experimental Evidence on the Impact of State Deposit Laws and Recycling Following Interstate Moves* 1, 6 (VAND. UNIV. L. SCH., Working Paper No. 20-37, 2020) [hereinafter *Quasi-Experimental Evidence*].

84. *Id.* at 4.

85. *Id.* at 4, 9. The discussion indicates that 3,902 households moved out of their county. Of these 3,902 households, 1,498 households relocated to a new state and 2,404 households relocated to a different county within the same state (author's analysis).

86. *Id.* at 4.

of-state moves with local moves provides a useful reference point for examining the effect of changes in the pertinent legal environment—as opposed to the impact of moving alone. Moving to states with stronger laws boosted the number of materials recycled, as did moving from a non-deposit state to a deposit state.⁸⁷ Meanwhile, moving from a state with a deposit policy to a state without a deposit policy had the opposite effect.⁸⁸ For some households, once the household no longer received the financial inducement of deposit policies, recycling rates declined.⁸⁹ This result is consistent with financial incentives being instrumental in fostering recycling behavior.⁹⁰ In contrast, moving to states with weaker recycling laws did not lead to a slackening of recycling behavior that was sufficiently great enough to be statistically significant. Households accustomed to recycling may continue to do so even in a new locale. Moving away from a regime with deposit policies differs from moves involving changes in the general recycling law, to the extent that the absence of a deposit policy also changes the mechanism for recycling. For example, if bottles and cans could be returned to retail establishments for refunds in a deposit state, that option will no longer be available when there is no deposit policy.

CONCLUSION

Most households cannot initiate recycling activity unilaterally. While it is possible to reuse some items within the household, having an external mechanism that facilitates a more broadly based recycling effort is essential. The two principal sets of legal interventions examined here consist of general recycling laws and container deposit policies. Each of these interventions can serve to boost recycling rates. While laws that simply announce a recycling goal are not influential, the findings discussed above indicate that enacting more stringent laws successfully boosts recycling rates. The hierarchy that we have found instructive for ordering the impact of these interventions is, in decreasing order of impact: mandatory recycling laws, recycling opportunity laws, and recycling planning laws. Similarly, container deposit laws also are effectively boost the recycling rates of affected products.

Recycling and deposit laws may also serve to promote pro-recycling social norms. Recycling of paper waste material increases after deposit policies encourage recycling of beverage bottles and cans.⁹¹ Diligent recyclers, particularly those in mandatory recycling states, indicate that they

87. *Id.* at 18–19.

88. *Id.* at 19.

89. *Id.*

90. *Id.*

91. *See infra* Figure 6 (showing recycling rates for paper in states with deposit laws compared to those without deposit laws).

are upset with their neighbors if they do not also recycle.⁹² Broader impacts of recycling policies on social norms could merit exploration in future studies. Engaging in recycling activity is a widespread pro-environmental household activity. Does recycling lead households to think more broadly about the importance of protecting the environment (possibly raising support for other environmental policies)? Many statistical analyses have found that households that label themselves as pro-environmental are more likely to recycle.⁹³ While the causality may be due to environmental attitudes making recycling more attractive, additionally, recycling may encourage people to have greater concern for the environment. The studies cited above did not ascertain the direction of causality in this relationship.⁹⁴

A policy question arising more frequently in recent years is whether recycling passes a broader economic test regarding the benefits outweighing the costs. The studies of this issue to date have focused on quantifiable economic effects, such as the costs of pickup, household recycling effort, landfill costs avoided, and the prices that can be gained by selling the recyclable materials.⁹⁵ Recycling may generate benefits exceeding the costs in some states but may have a different effect elsewhere.⁹⁶ Particular recycling approaches, such as the use of single-stream recycling, may pass a benefit-cost test, but there is no assurance that all recycling measures will be economically viable.⁹⁷ Fluctuations in recycled material prices may lead some to question recycling's economic desirability.⁹⁸

However, we hope that policymakers continue to think more broadly about recycling policies before contemplating any changes that would scale them back. Recycling behavior for households tends to be fairly stable from year-to-year. Temporary scaling back of recycling policies may disrupt this

92. Huber et al., *supra* note 79, at 15–17.

93. See, e.g., *Discontinuous Behavioral Responses*, *supra* note 30, at 140 (concluding that deposit laws have less of an impact on pro-environmental households that are already more likely to recycle).

94. See, e.g., *Quasi-Experimental Evidence*, *supra* note 83, at 1–2 (“While households in states with strict recycling laws or deposit regimes trend to exhibit greater recycling rates, it is not clear whether this difference is due to state environmental laws or is simply reflective of environmental preferences withing the state.”).

95. See, e.g., *Promoting Recycling*, *supra* note 54; see also e.g., *Discontinuous Behavioral Responses*, *supra* note 30; see also e.g., *Private Recycling Values*, *supra* note 73; see also e.g., Huber et al., *supra* note 79; see also e.g., *Quasi-Experimental Evidence*, *supra* note 83.

96. See David Aadland & Arthur J. Caplan, *Curbside Recycling: Waste Resource or Waste of Resources?*, 25 J. POL’Y ANALYSIS & MGMT. 855, 855 (2006) (discussing mixed results on the economic merits of recycling).

97. See, e.g., Orion Donovan-Smith, *When Does Recycling Your Plastic Make Sense? The Answer Isn’t So Simple*, PBS (Mar. 31, 2020), <https://www.pbs.org/wgbh/frontline/article/what-plastic-types-to-recycle/> (claiming that the benefits of recycling are clear for certain materials—like aluminum and paper—but less clear for plastics).

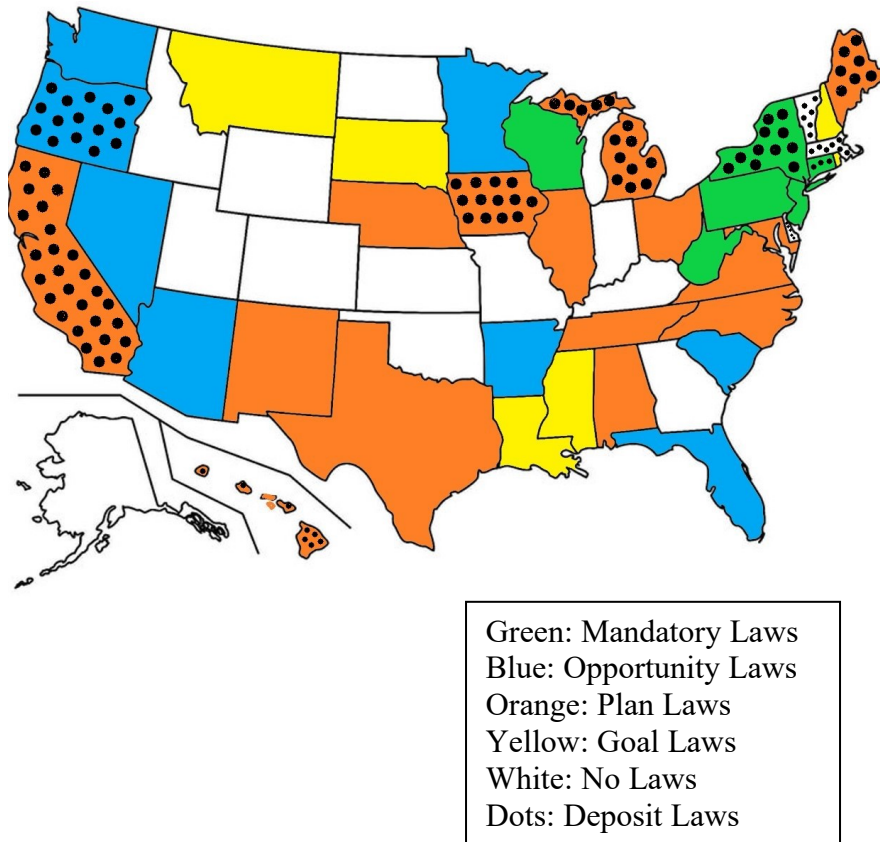
98. See, e.g., Gill Plimmer, *Recycling Industry Feels Strain of Falling Prices*, FIN. TIMES (Aug. 23, 2016), <https://www.ft.com/content/cc2f1612-63c2-11e6-8310-ecf0bddad227> (“The fall in prices for recycled goods has put pressure on every part of the waste management industry.”).

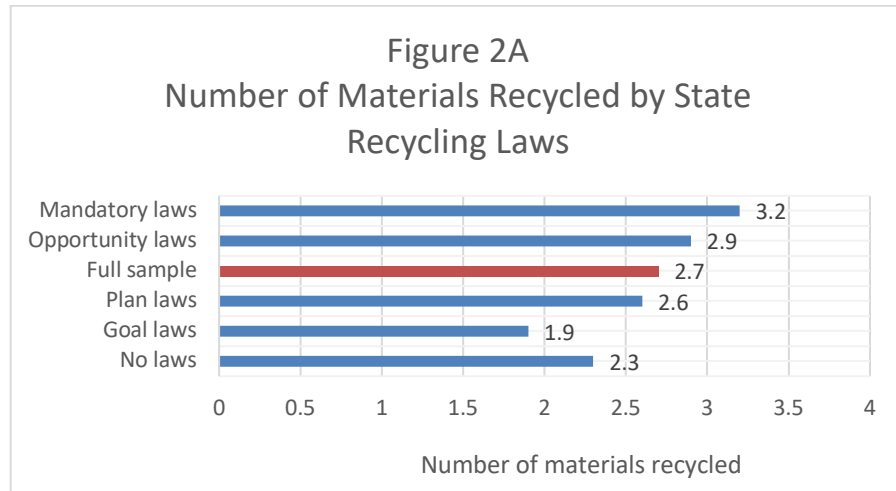
continuity in recycling habits, creating challenges in terms of regaining the recycling activity. Also, problems may arise in publicly communicating recycling's value if government officials change their attitudes on whether recycling is desirable based on recycled material's temporary price fluctuations.

Recycling policy assessments, seeking to monetize the costs and benefits of recycling, have not considered potentially broader impacts on support for pro-environmental policies. If engaging people in perceived pro-environmental household recycling efforts makes them more inclined to support environmental protection generally, incentivizing such efforts could pay dividends that go beyond the financial merits of recycled materials.

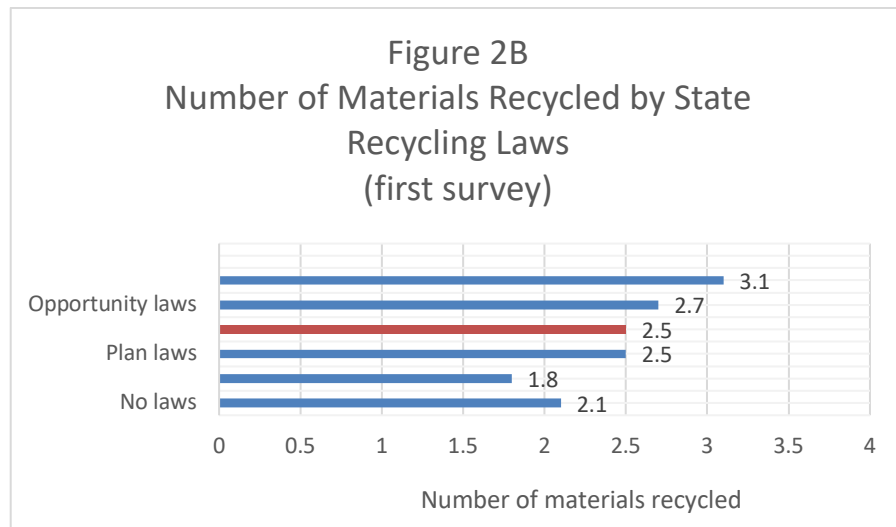
APPENDIX - FIGURES

Figure 1
USA Recycling and Deposit Laws

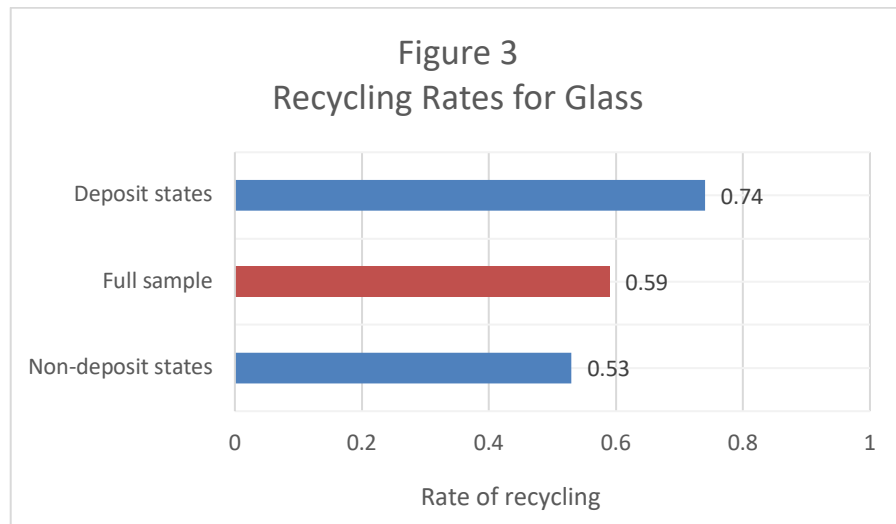




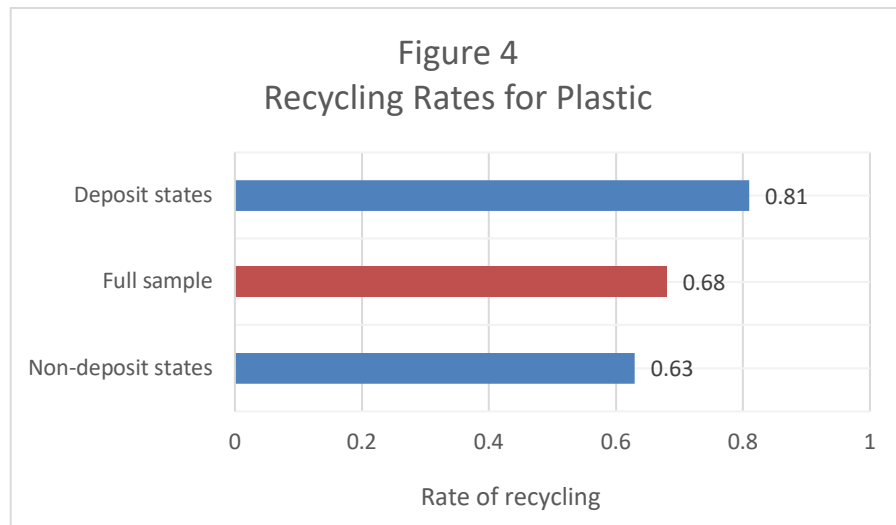
Notes: Sample consists of 406,952 observations, 2005–2014, Knowledge Networks Panel.



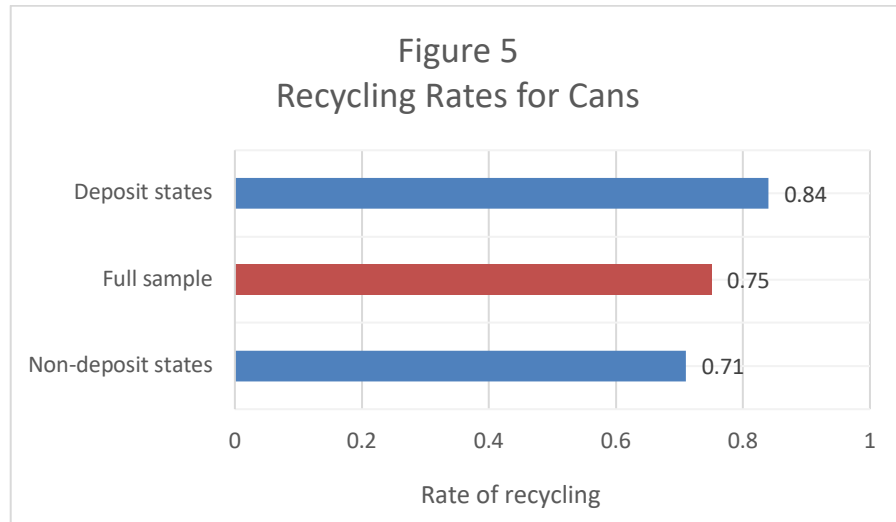
Notes: Sample consists of 171,296 observations based on respondent's first survey, 2005–2014, Knowledge Networks Panel.



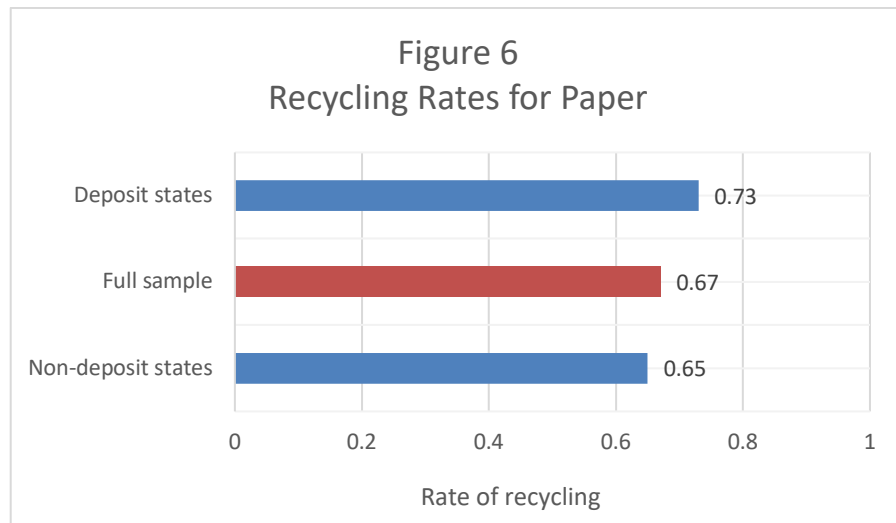
Notes: Sample consists of 406,952 observations, 2005–2014, Knowledge Networks Panel.



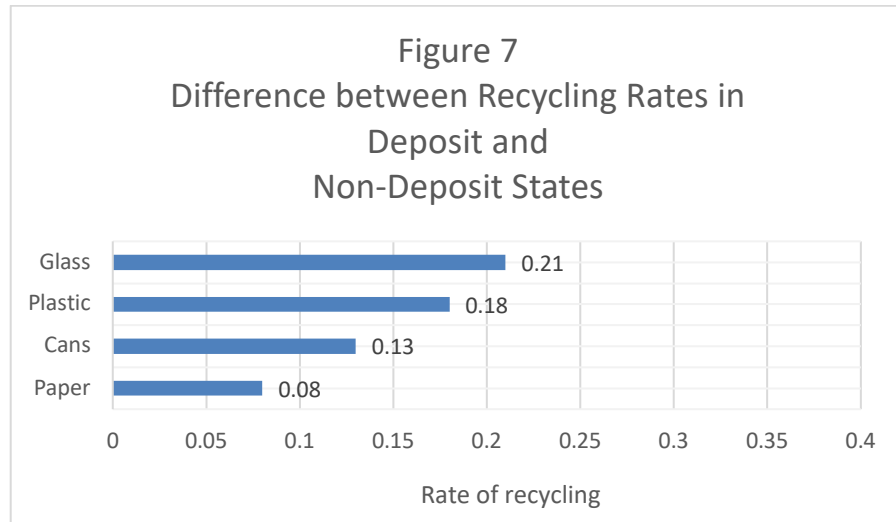
Notes: Sample consists of 406,952 observations, 2005–2014, Knowledge Networks Panel.



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APPENDIX - TABLES

Table 1
 Percentage Who Report Recycling Opportunity for Different Recycling Laws

Legal Regimes	Use curbside recycling	Use community center	Return for deposit
Mandatory laws	76	15	3
Opportunity laws	54	16	11
Plan laws	41	26	7
Goal laws	11	17	0
No laws	31	15	1
Full sample	47	20	6

Source: Data based on Table 4 of W. Kip Viscusi, Joel Huber, and Jason Bell, "Alternative Policies to Increase Recycling of Plastic Water Bottles in the United States," *Review of Environmental Economics and Policy*, 6(2), 2012, p.202.

Table A1
States With Mandatory Recycling Laws

State	Source
Connecticut	Conn. Gen. Stat. § 22a-241b.
DC	D.C. Code § 8-1007.
New Jersey	N.J.S.A. 13:1E-99.16.
New York	McKinney's General Municipal Law § 120-aa.
Pennsylvania	53 Pa. Cons. Stat. Ann. § 4000.1501.
West Virginia	W. Va. Code Ann. § 22-15A-18.
Wisconsin	Wis. Stat. Ann. § § 287.07 to .09.

Note: Categorizations are based on the state laws in place during the study period (2005–2014).

Table A2
States With Opportunity Recycling Laws

State	Source
Arizona	Ariz. Rev. Stat. Ann. § 9-500.07.
Arkansas	Ark. Code Ann. § 8-6-720.
Florida	Fla. Stat. § 403.706.
Minnesota	Minn. Stat. § 115A.552.
Nevada	Nev. Rev. Stat. Ann. § 444A.040.
Oregon	Or. Rev. Stat. § § 459A.005 to .010.
South Carolina	S.C. Code Ann. § 44-96-80.
Washington	Wash. Rev. Code Ann. § 70.95.090.

Note: Categorizations are based on the state laws in place during the study period (2005–2014).

Table A3
States That Require Waste Management Plans With Recycling
Considerations

State	Source for plan requirements	State recycling or waste reduction goal?
Alabama	Ala. Code § 22-27-45.	Yes (25%)
California	Cal. Pub. Res. Code § 41821.	Yes (50%)
Hawaii	Haw. Rev. Stat. § 342G-3.	Yes (50%)
Illinois	415 Ill. Comp. Stat. Ann. 15/4.	Yes (25%)
Iowa	Iowa Code Ann. § 455B.306.	Yes (50%)
Maine	Me. Rev. Stat. Ann. tit. 38, § 2133.	Yes (50%)
Maryland	Md. Code Ann., Envir. § 9-505.	Yes (20%)
Michigan	Mich. Comp. Laws Ann. § § 324.11533 to .11538.	No
Nebraska	Neb. Rev. Stat. § § 13-2031 to 2032.	Yes (50%)
New Mexico	N. M. S. A. 1978, § § 74-9-4-7.	Yes (50%)
North Carolina	N.C. Gen. Stat. Ann. § 130A-309.03.	Yes (40%)
Ohio	Ohio Rev. Code Ann. § 3734.53.	No
Tennessee	Tenn. Code Ann. § 68-211-813.	Yes (25%)
Texas	Tex. Health & Safety Code Ann. § 363.062.	Yes (40%)
Virginia	Va. Code Ann. § 10.1-1411.	Yes (25%)

Note: Categorizations are based on the state laws in place during the study period (2005–2014).

Table A4

States That Only Have a Recycling or Waste Reduction Goal

State	Source	Goal amount
Louisiana	La. Rev. Stat. Ann. § 30:2413.	25%
Mississippi	Miss. Code Ann. § 17-17-221.	25% (waste reduction)
Montana	Mont. Code Ann. § 75-10-803.	17%
New Hampshire	N.H. Rev. Stat. Ann. § 149-M:2.	40% (waste reduction)
Rhode Island	R.I. Gen. Laws § § 23-18.8-2 to .12-3.	35% (recycling waste); 50% (recycling beverage containers)
South Dakota	SDCL § 34A-6-60.	50% (waste reduction)

Note: Categorizations are based on the state laws in place during the study period (2005–2014).

Table A5
State Bottle Deposit Law Citations

State	Relevant Deposit Laws
California	Cal. Pub. Res. Code § § 14500-99 (West 2021).
Connecticut	Conn. Gen. Stat. Ann. § § 22a-243 to 245c. (West 2021)
Hawaii	Haw. Rev. Stat. Ann. § § 324-101 to 122. (West 2021)
Iowa	Iowa Code Ann. § § 455c.1-17. (West 2021)
Maine	Me. Rev. Stat. Ann. tit. 38, § § 3101-19. (West 2021)
Massachusetts	Mass. Gen. Laws Ann. ch. 94, § § 321-327. (West 2021)
Michigan	Mich. Comp. Laws Ann. § § 445.571-445.576. (West 2021)
New York	N.Y. Env't. Conserv. Law. § § 27-1001 to 27-1019. (West 2021)
Oregon	Or. Rev. Stat. Ann. § § 459a.700-459a.744. (West 2021)
Vermont	Vt. Stat. Ann. tit. 10, § § 1521-30. (West 2021)

Note: Categorizations are based on the state laws in place during the study period (2005–2014).