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Conveyance, envy, and homeowner choice of appliances

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ABSTRACT

Conveyance, i.e. the fact that an appliance purchased will be left in a dwelling when moving out, may lead homeowners to purchase appliances of lower quality or performance, because the extra costs are not entirely capitalized into the house sales price. Employing a discrete choice experiment with homeowners in the United States, this paper explores the effects of conveyance on homeowners' willingness-to-pay for various attributes of refrigerators. To account for the social nature of purchases when conveyance is likely to occur, it also tests the role of envy (elicited through an incentivized game). The findings provide evidence that conveyors are more likely than non-conveyors to purchase a smaller refrigerator, from a less well-known brand, and with lower customer ratings. In contrast, conveyance was not found to affect homeowners' choices when it comes to energy cost. In addition, envy was found to generally reinforce the negative effects of conveyance on homeowners' willingness-to-pay for several quality and performance attributes. While conveyance and its interaction with envy help explain why some homeowners choose certain quality/performance attributes of appliances, these factors do not appear to explain the energy efficiency paradox.

1. Introduction

The energy-efficiency paradox postulates that individuals and organizations refrain from adopting energy-efficient technologies even though these technologies appear profitable based on net present value calculations (e.g., Gerarden et al., 2015; Gillingham and Palmer, 2014; Jaffe and Stavins, 1994; Sorrell and O'Malley, 2004). Following Gerarden et al. (2015), the factors explaining this paradox may be classified into three categories: (i) market imperfections such as incomplete contracts stemming from asymmetric information, split incentives, and agency issues; (ii) behavioral anomalies such as present bias, myopia and loss aversion; and (iii) measurement errors stemming among other things from adopter preference heterogeneity.

This paper addresses two of these categories, market imperfections and measurement errors, thereby investigating two novel facets for each. Regarding market imperfection, we focus on conveyance (i.e. leaving one's appliances for the next homeowner in a dwelling when moving out) as an example of an incomplete contract; regarding measurement error, we focus on heterogeneity in envy, a relatively unstudied social preference.

A prominent example of an incomplete contract is the so-called landlord–tenant (or user–investor) problem. Because of information asymmetry and transaction costs (e.g. for working out contractual arrangements, for verifying the benefits of an investment accruing to a landlord and tenant—such as an increase in property value and lower energy expenditures, respectively), landlords and tenants cannot enter into contracts that ensure that landlords can recover investments in, say, insulation measures, which would benefit tenants through lower heating expenses. Technically speaking, the terms of a contract fail to specify the obligations of the contract partners (here a landlord and a tenant) under every possible set of contingent facts (Grossman and Hart, 1986). If landlords cannot pass on these costs to their tenants (e.g. via higher rents), they have no financial incentive to invest in such measures.

While the literature has long recognized the existence of the landlord–tenant problem (e.g. Davis, 2012; Gillingham et al., 2012; Krishnamurthy and Kriström, 2015; Schleich and Gruber, 2008), Sandler (2018) recently brought to the fore another type of incomplete contract for homeowners: conveyance. Specifically, Sandler (2018) suggests that the fact that appliances convey (i.e. are left in a dwelling for the next homeowner when the dwelling is sold) may lead homeowners to purchase less energy-efficient products, because conveyance shortens the expected length of ownership. The net present value of an appliance purchased may therefore be lower than what it would have been if the appliance had been kept for its entire useful lifetime

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—unless the value of the investment is fully capitalized into the real estate sales price. Like the landlord–tenant problem, asymmetric information (about appliance quality and performance) and transaction costs may prevent the seller and buyer of a dwelling from agreeing to a contract that ensures that the seller can fully recover her investments in energy-efficient appliances.

Relying on sales data on appliances in the U.S., Sandler (2018) concludes that the value of appliances (refrigerators and clothes washers) is not fully capitalized into housing prices when a homeowner moves and appliances convey. As a consequence, conveyance causes these households to buy less expensive appliances. Possible reasons for incomplete capitalization include the fact that the preferences of the original and new owners may differ,[1] and rounding off (housing prices are typically rounded off to the nearest thousand dollars, yet differences between the costs of energy-efficient and non-energy-efficient appliances are a few hundred dollars, at most). Sandler (2018) further finds "suggestive evidence" that, in states in which conveyance dominates, consumers tend to purchase smaller and less-fully featured refrigerators, leading incidentally to lower energy usage. In a recent study drawing on a demographically representative household survey in Spain, Faure and Schleich (2020) find correlational evidence suggesting that adoption of energy-efficient appliances is on average about 8 percentage points (or 13%) lower when appliances convey for both renters and homeowners.

Lacking sufficient data, Sandler (2018) could not disentangle energy performance from other possibly correlated features, which may lead to a spurious association between low price and low energy efficiency. The lower price of refrigerators in states where conveyance is the default may for instance be explained by smaller size or lower quality rather than lower energy efficiency. Likewise, if quality or brand are positively correlated with energy performance, buyers valuing quality (or brand) may incidentally purchase more energy-efficient appliances. Similarly, the findings reported by Faure and Schleich (2020) may reflect the fact that more energy-efficient appliances also are of higher quality or perform better than less energy-efficient appliances. Existing studies therefore do not allow testing for such effects or for clearly identifying the effects of conveyance on the adoption of energy-efficient appliances. In the present research, the use of a discrete choice experiment (DCE) makes it possible to disentangle the effects of price, size, brand, quality, and energy cost.

Gerarden et al. (2015) identify heterogeneity in preferences as a main source of measurement errors when studying energy-efficient technology adoption. Previous research has investigated the link between the adoption of energy-efficient technologies and heterogeneity in time and risk preferences (e.g. Bradford et al., 2017; Qiu et al., 2014; Schleich et al., 2019), in environmental attitudes (e.g., Di Maria et al., 2010; Ramos et al., 2015), and in social preferences, especially social norms (e.g., Allcott, 2011). In a recent working paper, Fischbacher et al. (2018) study the impact of a novel type of social preference, envy, on energy-efficient technology adoption.[2] They find that envious homeowners are more likely to invest in energy-efficient measures such as home insulation; they reason that investments in energy efficiency might be driven in part by envious homeowners' dislike for being behind. As Fischbacher et al. (2018) do not consider a concrete social interaction such as conveyance, however, the social dimension is rather indirect in their study.

In the context of conveyance, the fact that an appliance adopted will be used by a future house buyer adds a concrete social dimension; as a consequence, in addition to individually centered preferences, socially centered preferences, especially envy, may affect the characteristics of the chosen appliance. Because the value of individual appliances may not be fully capitalized into housing prices, envious potential house sellers might resent the fact that house buyers receive high-quality appliances at little to no extra cost. This reasoning is anchored within a large body of empirical literature revealing that envious individuals react negatively when others are better off or receive undeserved payments (e.g. Zizzo and Oswald, 2001; Beckman et al., 2002; Casal et al., 2012).

To sum up, in this paper we investigate the impact of expected conveyance on homeowners' willingness-to-pay (WTP) for attributes of new refrigerators (including energy costs as a proxy for energy performance) and also analyze the moderating role of envy on WTP for these attributes. To do so, we conducted a survey among homeowners in the U.S., which included a DCE and an incentivized envy game.

Our paper adds to the extant literature in two ways. First, we provide empirical evidence pertaining to whether conveyance (i.e. incomplete contracts) leads homeowners to purchase appliances of lower quality or performance (such as energy performance), thus complementing work by Sandler (2018) and Faure and Schleich (2020). Second, we investigate the moderating role of a novel type of social preference, envy, which we expect to play a strong role in situations that involve multiple actors (here current and future homeowners). Our findings offer new insights into the factors explaining the energy-efficiency paradox and provide guidance for policy.

Our results provide evidence that conveyance negatively affects the quality of the brand and customer ratings of appliances, and—as in Sandler (2018)—results in the purchase of smaller refrigerators. But in contrast to Faure and Schleich (2020), we found no indication that conveyance is related to energy performance. In addition, our results suggest that envious conveyors prefer to purchase refrigerators from less well-known brands, with lower customer ratings (and also with shorter warranty periods) than non-envious conveyors. Thus, envy tends to reinforce the effects of conveyance on homeowner appliance choice.

The remainder of the paper is organized as follows. Section 2 presents a formal conceptual model linking appliance choice with conveyance and envy. Section 3 presents the empirical methodology, including the survey with the stated preference DCE, an incentivized game to elicit respondents' envy, and the econometric model. Section 4 reports the results. The final Section 5 summarizes and discusses the main findings.

2. Conceptual model of appliance choice

We modify the model of consumer choice of an energy-consuming durable good presented in Sandler (2018) and Brent and Ward (2018) to illustrate how conveyance and envy can affect consumer appliance purchase decisions and to derive hypotheses for the empirical analysis.[3] Embedded in the random utility framework for consumer choices of durable goods (McFadden, 1974), the model assumes that each consumer buys one appliance from a set of appliances with varying characteristics (in this case, a homeowner buying one refrigerator from a set of refrigerators). Homeowner i's preferences for appliance j may be captured by the following intertemporal utility function

$$U_{ij} = \sum_{t=0}^{T} \delta^t \beta_i X_j + \sum_{t=T+1}^{TI} \gamma_i(c_i; e_i) \delta^t \beta_i X_j - p_j + \varepsilon_{ij} \quad (1)$$

where X_j is a vector of K product characteristics (e.g. size, quality, energy cost) of appliance j, the vector β_i captures homeowner i's preferences for these characteristics with $\beta_{ik} > 0$ for benefits (e.g. size, quality) and $\beta_{ik} < 0$ for costs (e.g. energy cost), δ^t denotes the time-discount factor, p_j stands for the purchasing cost of appliance j, and ε_{ij} is an idiosyncratic error term. The preferences for the purchasing cost are normalized to one. The first summation in Eq. (1), $\sum_{t=0}^{T} \delta^t \beta_i X_j$, corresponds to the discounted

[1] Houde (2016) finds substantial heterogeneity in consumer valuation of energy efficiency in appliances.

[2] To be precise, Fischbacher et al. (2018) study envy and fairness preferences. Envy also differs from inequity aversion. An envious person dislikes inequity if she is worse off than others (but not if she is better off than others). The fact that the buyer of a house receives high-quality appliances at little to no extra cost might be considered inequitable by the seller of the house. In contrast to an envious person, an inequity-averse person always dislikes inequity—whether she is better off or worse off than others.

[3] Sandler (2018) and Brent and Ward (2018) rely on the conceptual framework developed by Allcott et al. (2014).

present value of the streams of net benefits of purchasing appliance j during time of ownership T. The second summation, $\sum_{t=T+1}^{Tl} \gamma_i(c_i; e_i)\delta^t \beta_i X_j$, represents the discounted net present scrap value of appliance j when ownership ends (i.e. the capitalized value of any remaining future net benefits). If the homeowner moves and the appliance conveys, the homeowner may not fully capitalize any remaining future net benefits because preferences of the original and new owners differ or because housing prices are typically rounded off. Thus, individuals expecting that their appliances convey when moving might not expect to fully recover their investments in higher quality or better-performing (and hence more expensive) appliances.

We introduce a vector of weights γ_i to capture the idea that homeowner i may then place a lower value on some or all of the K product characteristics. In particular, our model allows these weights to be a function of conveyance (c_i) and of the level of envy (e_i) of consumer i. We hypothesize that the indicator c (which takes on the value 1 if the appliance conveys and 0 else) lowers the weight homeowners place on a particular quality/performance characteristic.[4] In particular, we define

$$d_i(e_i) = \gamma_i(1; e_i) - \gamma_i(0; e_i) < 0 \tag{2}$$

We further hypothesize that envy creates a psychological cost to conveyors. This cost is proportional to the portion of remaining net benefits of appliance j, which conveyor i cannot capitalize when the dwelling is sold. In particular, we posit

$$\frac{\partial d_i(e_i)}{\partial e_i} < 0 \tag{3}$$

Thus, the negative effects of c_i on γ_i are larger for more envious consumers.[5]

Finally, we draw on Eq. (1) to illustrate the effects of shortening the length of ownership T. A shorter duration of ownership lowers the discounted present value of the streams of net benefits which are not compensated for by an increase in the discounted net present scrap value if $\gamma_i(c_i; e_i) < 1$. In this case, assuming that higher quality and better performing appliances are more expensive, optimizing individuals will choose an appliance with lower quality/poorer performance when the duration of ownership is shortened.

3. Material and methods

To test the model presented in Section 2, we employ a stated preference DCE with homeowner households in the United States. As postulated in the familiar goods-characteristics approach (Lancaster, 1966) and the random utility framework (McFadden, 1974), in a DCE a consumer derives utility from the characteristics of products and chooses the preferred option available to her. A DCE simulates market transactions by constructing hypothetical choice scenarios where alternatives are described by a range of attributes, and where respondents are expected to make trade-offs between these attributes and select their most highly preferred alternatives. This makes it possible to estimate the values for multiple attributes of a product and their trade-offs simultaneously.

We focus on the U.S. market because mobility in the U.S. is rather high and conveyance of major appliances is quite common. According to recent data collected by the U.S. Census Bureau, the average American citizen moves 11.7 times during his or her life. Likewise, between 2016 and 2017, about 11% of the U.S. population and 6% of homeowners changed homes.[6] We focus on refrigerators because these appliances often (but not always) convey in the U.S. market.

Several studies have previously carried out choice experiments with appliances, mostly with refrigerators. Revelt and Train (1998) analyze a series of hypothetical choices between refrigerators differing in price, energy efficiency and savings, and available financing (loans at varying interest rates and rebates). Similarly, Ward et al. (2011) ask respondents to make hypothetical choices regarding refrigerator purchase options and an outside option. In their choice experiment, refrigerators are characterized by the attributes price, configuration (e.g. French door), brand, external ice and water dispenser, capacity, and Energy Star label. Li et al. (2016) analyze data from the same choice experiment as Ward et al. (2011) but include an additional treatment group in which respondents are told that Energy Star–certified refrigerators qualify for mail-in rebates. Comparing the two treatment groups, the authors examine the effects of mail-in rebates for Energy Star-certified refrigerators on stated choices.

Some studies have focused on the effectiveness and welfare implications of the information provided on energy labels. Employing a DCE for water heaters, Newell and Siikamäki (2014) explore the effectiveness of alternative labeling treatments. They find that providing simple information on annual operating costs is the main driver of more cost-efficient technology choices. In comparison, information on physical energy use and CO_2-emissions are less important. Conducting a DCE for air conditioners, Davis and Metcalf (2016) find that providing operating cost information based on state-level usage and prices (rather than national usage and prices) on the U.S. EnergyGuide label leads to welfare-improving technology choices. Finally, in their DCE for purchasing a hot water heater, Brent and Ward (2018) find that participants with higher financial literacy are more likely to select investments with the lowest lifetime discounted total costs. We used these studies as guidance for the design of our DCE.

In the following section we describe the survey (including the DCE) and the statistical model used to estimate the parameters. Our empirical methodology relies on an online survey of U.S. homeowners. The survey includes a questionnaire on housing and household characteristics, an incentivized game to elicit envy preferences, and a DCE for refrigerator purchases. We further collected household-level information on moving plans and intentions to convey, thus allowing us to directly test whether households that are planning to move in the near future and convey their appliances purchase less energy-efficient refrigerators.

3.1. Survey

We implemented an online survey via computer-assisted web interviews (CAWI) among 504 homeowners in the U.S. using an existing panel from Prolific Academic. Prolific Academic is a crowdsourcing platform that permits recruitment of participants for academic research studies; the platform has been tested and validated by academic researchers (Peer et al., 2017). The survey was fielded in June 2018. Participants were selected via quota sampling to be roughly representative in terms of gender and regional population dispersion; only participants who reported being involved in their households' investment decisions qualified to respond to the survey.

3.1.1. Description of choice experiment

The main part of the survey consisted of a stated preference DCE. Participants were asked to imagine that their refrigerator had broken

[4] Brent and Ward (2018) model γ_i as a function of household characteristics and financial literacy. In particular, γ_i is supposed to be lower for individuals with lower financial literacy.

[5] If homeowners move and an appliance does not convey, homeowners may sell their appliance on the second-hand market. In this case, and like the case where the appliance conveys, capitalization may be incomplete because the preferences of the seller and the buyer differ. In addition, the buyer may exploit a situation where the seller is forced to sell her appliance upon moving, resulting in a low price. In this case, $\gamma_i(0; e_i)$ might also vary with envy and the sign of $d_i(e_i)$ is generally ambiguous. In Section 4.3.4 we further explore and discuss the situation of non-conveyors with moving plans.

[6] See CPS Historical Migration/Geographic Mobility Tables, Table A-4 in https://www.census.gov/data/tables/time-series/demo/geographic-mobility/historic.html.

Table 1
Levels of attributes considered in the choice experiment.

Attribute	Levels
Energy cost	$54; $66; $78; $90
Capacity	18 cu. ft.; 20 cu. ft.; 22 cu. ft.; 24 cu. ft.; 26 cu. ft.; 28 cu. ft.
Warranty	1 year; 3 years; 5 years
Brand	Well-known quality brand; lesser-known brand
Customer review	2.5/5 stars; 3.5/5 stars; 4.5/5 stars
Price	$799; $999; $1199; $1399; $1599; $1799

down and thus needed to be replaced. The following framing was used to introduce the choice experiment:

> "*Imagine that your refrigerator has broken down and you need to buy a new one. (In case you have several refrigerators, please imagine that the one you use most has broken down.) On the following pages, we will show you different refrigerator purchase options. We would like to know which refrigerator you would choose, if these were your only options. Please assume that all refrigerator options fit properly in your kitchen and are currently available in color and finish of your choice.*"[7]

Respondents were then asked to make a series of choices between refrigerator purchase options (see Figure A1). These options differed by energy cost, capacity, length of warranty, brand, customer review ratings, and purchase price (attributes and levels are summarized in Table 1). Attributes were chosen to represent relevant information for customers choosing a refrigerator and to be independent of one another. The capacity, brand, and purchase price have already been used in choice experiments on refrigerator purchase (Ward et al., 2011). Energy cost is used as a proxy for energy consumption. We added to this list two quality attributes: length of warranty and customer review ratings.

Overall, the attributes were chosen to cover the majority of models on the refrigerator market in the U.S., therefore including the most common ranges of sizes and prices available at the time of the study. Extreme values (for instance mini-refrigerators) were left out so that the choices proposed could be realistic and comparable and that the majority of consumers could seriously consider each option proposed. Information on energy consumption was provided as the estimated yearly cost to run the refrigerator; the values proposed (ranging between $54 and $90 a year) were calculated based on average electricity use and national electricity prices. We expected consumers who intend to move and to leave their refrigerator in a house when moving (hereafter called conveyors for simplification) to choose less energy-efficient appliances. Size or capacity has been shown to be a particularly important attribute for refrigerator choice in the U.S. (see for instance Ward et al., 2011), with consumers preferring larger refrigerators; we included six sizes in the design, with increases of two cubic feet at a time (equivalent to an extra drawer); here again, we expected conveyors to choose smaller refrigerators compared to non-conveyors.

We included three quality indicators. Length of warranty was chosen to vary from one to five years. We expected this attribute to be of lesser importance for conveyors because they would move too early to benefit from a longer warranty. To avoid biases reflecting diverging previous experience and preferences for specific brand names, the attribute brand was kept general and included two levels—either a well-known quality brand or a lesser-known brand. Customer ratings, which have been shown to have a great impact on purchase decisions (e.g. Chevalier and Mayzlin, 2006; Moe and Trusov, 2011), were also included with the typical visual five-star representation used in many online shops; we included three levels, ranging from 2.5 stars to 4.5 stars. We generally expected conveyors to assign less importance to these quality attributes than non-conveyors because conveyance shortens the length of ownership and prevents the costs associated with a better brand, longer warranty, or a higher customer rating to be recouped, because they are not capitalized in higher housing prices. In the subsequent econometric analysis, we chose the 3.5-star level as the reference level because it reflects a moderate view (Mudambi and Schuff, 2010).

In the U.S., refrigerators are Energy Star–certified if they use 10% less measured energy than the minimum federal efficiency standards. The standard depends, among other things, on the capacity of the refrigerator. Taking this into consideration and wanting to be realistic, in our choice experiment refrigerators with an energy cost of $54 (the lowest level) were displayed with an Energy Star for all levels of capacity. Refrigerators with an energy cost of $66 (the second lowest level) were displayed with an Energy Star only if capacity was high (26 cu. ft. or 28 cu. ft.). Refrigerators with higher energy costs were never displayed with an Energy Star.

To reduce the large number of treatment combinations and increase the efficiency of design, we applied a Bayesian efficient design (Sándor and Wedel, 2001) using NGENE software (ChoiceMetrics, 2014). The priors used for the design were obtained from a pilot study with 50 U.S. homeowners. Our choice experiment consisted of 24 scenarios divided into three blocks. Each respondent was randomly assigned to one of the blocks and faced eight scenarios. Appendix A depicts an example of a scenario shown to respondents.

3.1.2. Elicitation of envy preferences

Following the choice experiment, respondents took part in an incentivized envy game inspired by Fehr et al.'s (2008) envy game and by Güth's (2010) generosity game. In our game, respondents were informed that one out of every 100 respondents would be selected at random to receive an amount between zero and 100 U.S. dollars in addition to the participation fee. The exact amount would be determined by another randomly selected respondent. Respondents were then asked to indicate how much another participant should receive in case they were selected to determine this amount.[8] We further informed respondents that they could be selected either as a receiver or as a giver, but not both, thus excluding any form of reciprocity from the game. Lastly, respondents were reminded that their answers were binding and anonymous. Appendix B provides the exact wording of the envy game as used in the survey.

We anticipated that envious respondents who allocate low amounts or nothing to another player also dislike leaving high-quality/high-performance appliances when selling their houses. In our choice experiment, we thus expected to observe a lower WTP for quality/performance-related attributes for envious respondents than for non-envious respondents if a refrigerator is likely to convey.

3.1.3. Questionnaire

Additional survey questions addressed dwelling and appliance characteristics, moving plans, and respondents' intention to leave their refrigerator when selling their home and their perception of conveyance norms. Socio-demographic information was gathered both at the beginning of the questionnaire (to ensure that quota requirements were met), and at the end of the questionnaire.

3.2. Econometric model

3.2.1. Mixed logit model in WTP space

Our econometric analyses employ mixed logit models, because, unlike conditional logit models, they do not rely on the Independence of

[7] Adapted from similar framing in Ward et al. (2011) and Li et al. (2016).

[8] Under the minimum allocation, receivers and givers both receive only the participation fee. The most envious allocation thus corresponds with the equity allocation (as in Fehr et al.'s (2008) envy game). In this case, envy and inequity aversion lead to identical allocations and cannot be distinguished. Moreover, we cannot exclude the possibility that envious allocations result from participants' being indifferent to others' payoffs and randomizing their answers.

Irrelevant Alternatives assumption and also account for unobserved heterogeneity in individual preferences (Revelt and Train, 1998). Following Train and Weeks (2005), we apply the mixed logit model in WTP space. In this case, the estimated parameters represent the WTP values, and their distribution is directly specified.

In our case, we assume that the utility a respondent i derives from choosing refrigerator j in choice situation t is given as:

$$U_{ijt} = \alpha_i p_{ijt} + \beta_i X_{ijt} + \varepsilon_{ijt} \quad (5)$$

where p_{ijt} is the price of refrigerator j, and X_{ijt} is a vector that includes the attributes of our choice experiment. α_i and β_i are individual random parameters, and ε_{ijt} is an error term following an extreme value distribution with variance $Var(\varepsilon_{ijt}) = k_i^2(\pi^2/6)$, where k_i is the scale parameter for the ith individual. Dividing Eq. (5) by k_i does not change household i's behavior and yields a new error term e_{ijt} following an extreme-value distribution with variance $\pi^2/6$:

$$U_{ijt} = \lambda_i p_{ijt} + c_i X_{ijt} + e_{ijt} \quad (6)$$

where $\lambda_i = \alpha_i/k_i$, $c_i = \beta_i/k_i$. Eq. (6) corresponds to the model in preference space. The WTP for a given attribute is obtained through the ratio $\mu_i = c_i/\lambda_i$.

Dividing both sides of Eq. (7) by λ_i, we obtain:

$$\tilde{U}_{ijt} = p_{ijt} + \mu_i X_{ijt} + \tilde{e}_{ijt} \quad (7)$$

where $\tilde{U}_{ijt}$ and $\tilde{e}_{ijt}$ in Eq. (7) are the rescaled expressions of U_{ijt} and e_{ijt} from Eq. (6). Reparametrizing our model in this way, the parameters obtained through the mixed logit estimation yield the (marginal) WTP for attributes $\mu_i = \frac{c_i}{\lambda_i}$. As is standard in the literature, we assume that μ_i follows a normal distribution. The model is estimated via maximum simulated likelihood methods (Train, 2009). We used 350 Halton draws in our simulations.

3.2.2. Types of models estimated

We first estimated a *base model* which includes the attributes only. To test Eq. (2), we then ran a *conveyance model* exploring the impact of conveyance on WTP for quality/performance-related attributes of refrigerators, especially for likely conveyors. For this test, the *conveyance model* includes a vector of interaction terms between these attributes and a dummy variable, *convey*, which distinguishes conveyors from non-conveyors. The estimated parameters of these interaction terms are specified as fixed parameters.

To test for the sensitivity of findings to future moving plans, we ran three specifications of the *conveyance* model. In the *simple convey model*, *convey* takes the value of one if respondents stated that they would leave their refrigerator with the home when they sold their current home.[9] This is the case for 61.6% of our sample. Implicitly, the *simple convey* model presumes that conveyance may affect homeowners' appliance purchase decisions even if they have no concrete plans to move in the near future. Simply knowing that the appliance would convey is assumed to affect appliance choice because the possibility of moving exists even in the absence of concrete moving plans. In two alternative specifications, we also use participants' stated future moving plans to characterize conveyors. In the *convey-move5* (*convey-move2*) model, conveyors are defined as respondents who stated they would leave their refrigerator with the home when they sold their current home and that they planned to move within the next five (two) years.[10] The share of conveyors is 26.2% in the *convey-move5* model and 12.5% in the *convey-move2* model, corresponding to 132 and 63 respondents, respectively.

To test for the effects of envy on refrigerator characteristics, as proposed in Eq. (3), we ran a *conveyance-envy interaction* model in which we interacted the dummy variable *highenvy* with each attribute and with the interaction terms between convey and the quality/performance-related attributes. *Highenvy* took the value of one if respondents gave at most the median amount in the envy game. This three-way interaction model allows for direct inference of the effects of envy for conveyors versus those for non-conveyors. The estimated parameters of all interaction terms in the *conveyance-envy interaction* model are specified as fixed parameters.

4. Results

Our presentation of the results distinguishes between the summary statistics for the sample, the findings of the envy game, and the econometric results of the mixed logit models.

4.1. Sample summary statistics

As displayed in Table 2, our sample resembles the U.S. population in terms of distribution across the four most populous states (California, Texas, Florida, New York) and gender. As for age, respondents between 25 and 44 years old—arguably the age group that is the most mobile—were overrepresented in our survey. Mean income in our sample is lower than in the U.S. population, most likely owing to capping of the top income bracket within the survey. In comparison, education levels in our survey are substantially higher than in the U.S. population, probably because we limit our sample to homeowners, who are likely to be better educated than the average U.S. resident. Most importantly, the results reported in Table 2 suggest that conveyors are very similar to the full sample in terms of key socio-demographic characteristics.

4.2. Envy game summary statistics

The distribution of the amounts chosen in the envy game is depicted in Fig. 1. We observe that 45% of respondents chose the so-called efficient outcome, i.e. $100. At the same time, 26% of the respondents opted for an allocation in which the receiver received nothing except the participation fee, thus reflecting strong envy. The remaining 29% of respondents revealed some degree of envy by choosing outcomes between $0 and $100, with a small kink at $50 (6% of respondents). The mean amount chosen was $61.14 and the median was $86.

These results are in line with previous findings reported in the literature. In similar games, Güth et al. (2012) found that >50% of participants allocated less than the maximum amount to another player if

Table 2
Summary statistics for the sample.

	Full sample	Conveyors	U.S.
Most populous states	35%	32%	33%[a]
Female	46%	46%	51%[a]
Age (between 18 and 84)			
18 and 24 years	8%	6%	12%[a]
25 and 44 years	64%	67%	35%[a]
45 and 64 years	24%	22%	34%[a]
65 and 84	4%	5%	19%[a]
Income (mean, $US)	62192[b]	63593[b]	87643[c]
Higher education degree	76%	78%	38%[c]
Plan to move within the next 5 (2) years	39% (18%)	38% (19%)	n.a. (n.a.)

[a] U.S. Census Bureau, Annual Estimates of the Resident Population, 2018.
[b] Household annual income (after taxes) in 2017 (using the midpoints of 12 income brackets, and the lower level of the highest income bracket, i.e. $88.800).
[c] U.S. Census Bureau, Current Population Survey, 2018 Annual Social and Economic supplement.

[9] The survey asked the following question: (1) "If you sold your current home, would you leave your refrigerator with the home?" [Answer categories: Yes/No/Don't know].

[10] The survey included the following question: "Which of the following best describes your future moving plans?" [Answer categories: I will likely change my primary residence within the next 2 years/3 to 5 years/6 to 10 years/I will likely not change my primary residence within the next 10 years].

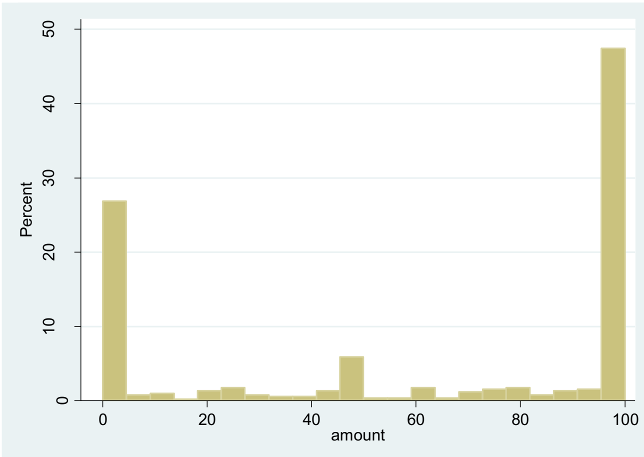

Fig. 1. Distribution of amounts chosen in the envy game.

their own payoff was fixed at a lower level. Similarly, almost 60% of participants in Fischbacher et al. (2018) chose inefficient allocations.

In this study, respondents had a one in one hundred chance of being selected as the winner of the envy game. Of the 504 participants, five were randomly selected as winners; in total, gains of $307 were distributed (for an average of $61.4 per winner, ranging from $0 to $100).

4.3. Results for mixed logit models

We first present the findings of the *base* model (Table 3). We then describe the results of the *conveyance* model (also Table 3), focusing on the terms representing interaction between conveyance and the refrigerator attributes. Finally, in Table 4 we present the main findings for the *conveyance-envy-interaction* model, i.e. terms representing three-way interaction between conveyance, envy, and the refrigerator attributes. In Table 3 and Table 4 we report the findings for the estimated means of the coefficients. Results for the estimated standard deviations of the coefficients are reported in Appendix C Table A1 for the *conveyance* model and in Appendix E Table A3 for the *conveyance-envy-interaction* model. Most standard deviations of the coefficient estimates are statistically significant, suggesting heterogeneity across respondents and thus corroborating the use of a mixed logit model.

Table 3
Mixed logit model results in WTP space for *base* and *conveyance* models (clustered standard errors in parentheses) - Means.

	Base	*Conveyance model*		
		Simple convey	*Convey-move5*	*Convey-move2*
Price	−5.86***	−5.92***	−5.87***	−5.92***
	(0.10)	(0.09)	(0.09)	(0.09)
Energy cost	−7.87***	−8.64***	−7.86***	−7.58***
	(0.85)	(1.38)	(1.00)	(0.89)
Capacity	60.45***	58.07***	60.73***	62.72***
	(3.91)	(6.31)	(4.44)	(4.27)
Warranty	59.23***	56.41***	61.43***	62.23***
	(6.89)	(11.38)	(7.75)	(7.73)
Brand	178.89***	230.07***	203.59***	211.00***
	(22.25)	(37.32)	(26.85)	(24.17)
2.5 stars	−454.49***	−475.17***	−455.92***	−481.46***
	(30.69)	(32.44)	(30.77)	(31.22)
4.5 stars	184.82***	218.45***	218.69***	212.59***
	(29.97)	(44.19)	(35.35)	(32.39)
Convey × energy cost		1.44	−0.69	−0.91
		(1.62)	(1.75)	(2.36)
Convey × capacity		3.69	−4.12	−20.73*
		(8.07)	(8.82)	(11.88)
Convey × warranty		7.41	−6.56	−8.26
		(14.33)	(15.09)	(20.48)
Convey × brand		−76.84*	−102.42**	−227.16***
		(46.66)	(50.18)	(65.88)
Convey × star4.5		−41.69	−141.30**	−139.41**
		(52.81)	(56.80)	(70.97)
Log likelihood	−2151.5711	−2151.6061	−2147.6056	−2145.9981
N	8048	8048	8048	8048

* $p < .10$.
** $p < .05$.
*** $p < .01$.

Table 4
Mixed logit model in WTP space for envy-conveyance interaction model (clustered standard errors in parentheses) - Means of three-way interaction terms.

	Envy-conveyance interaction model		
	Simple convey	*Convey-move5*	*Convey-move2*
Convey × highenvy × energy cost	−2.56	0.30	2.33
	(3.33)	(3.46)	(4.76)
Convey × highenvy × capacity	0.65	2.73	−16.83
	(16.81)	(17.84)	(21.24)
Convey × highenvy × warranty	−44.00	−46.13	−5.49
	(29.04)	(31.44)	(38.92)
Convey × highenvy × brand	−150.38*	−189.96*	−123.71
	(89.09)	(104.93)	(132.23)
Convey × highenvy × star2.5	139.03	54.48	−180.68
	(126.53)	(135.53)	(188.69)
Convey × highenvy × star4.5	−218.57**	−252.78**	−244.27*
	(99.22)	(121.52)	(140.21)
N	8048	8048	8048

* $p < .10$.
** $p < .05$.
***$p < .01$.

4.3.1. Base model

Turning to the first column of Table 3, we observe that all main effects are statistically significant and exhibit the expected signs.[11] The coefficient associated with price is statistically significant and, as expected, negative. Employing the point estimates for interpretation, the findings for *energy cost* suggest that, on average, respondents are willing to pay about $8 less if the annual energy costs of the refrigerator increase by $1. This figure appears reasonable, given expected lifetimes of refrigerators of more than ten years and time-discounting of future energy cost savings by respondents.[12] Respondents also prefer larger refrigerators. We find that the average respondent is willing to pay about $60 for an extra cubic foot of volume. For an additional year on a warranty, the average respondent in our sample would spend $59. Respondents are also willing to pay more for higher-quality brands. Compared with a lesser-known brand, the average respondent would spend an extra $179 for a well-known quality brand. Finally, compared with a refrigerator with a 3.5-star rating (i.e. the base category), respondents are willing to pay $454 less for a 2.5-star-rated refrigerator and $184 more for a 4.5-star rated refrigerator. Clearly, respondents' preferences for customer ratings are not linear in the classification levels and the average respondent displays a strong dislike for refrigerators with low customer ratings.

[11] To test whether the Energy Star label itself had an effect on refrigerator choice in our DCE, we also ran a mixed logit model including "Energy Star" as an additional attribute. The parameter for the "Energy Star" attribute was not found to be significant. In line with Newell and Siikamäki (2014) this suggests that participants based their stated purchase decisions in the DCE on energy costs rather than the Energy Star label.

[12] In our sample, the average self-estimated expected lifetime (usage time) of respondents' refrigerators was slightly below 12 years.

4.3.2. Conveyance model

For all three specifications of the *conveyance* model, we focus on the signs and significance of the interaction terms representing relationships between *convey* and the refrigerator attributes, while noting that the results for the main variables are virtually the same as those for the *base* model.

First, for the *simple convey* model, where respondents' moving plans were not considered when defining conveyors, only one of the interaction terms turned out to be statistically significant, yet only at the 10% level. The finding for *brand* suggests that, on average, conveyors are willing to pay almost \$77 less for a high-quality brand than non-conveyors.

Second, the findings for the *convey-move5* model, where respondents' moving plans for the next five years were taken into account when defining conveyors, suggest that likely conveyors exhibit a lower WTP for a well-known quality brand and for a higher customer rating. Compared with non-conveyance, conveyance lowers the WTP for a higher quality brand by \$102 and for a refrigerator with a 4.5-star customer rating (compared with a 3.5-star rating) by \$141.

Third, for the *convey-move2* model, where respondents' moving plans for the next two years were taken into account when defining conveyors, the discount for a 4.5-star customer rating is similar to that in the *convey-move5* model, but the discount for a well-known brand is even larger, i.e. \$227. In addition, for the *convey-move2* model, conveyance is found to affect the WTP also for capacity at a statistically significant level. More specifically, conveyance lowers the WTP by about \$21 per additional cubic foot of volume.

To test whether the effects of conveyance on the WTP for quality/performance-related attributes are stronger if homeowners expect to move within the next two rather than the next five years, we also estimated a model which includes two sets of conveyance–attribute interaction terms, i.e. one for five-year moving plans and one for two-year moving plans. Results derived from this model appear in Appendix D Table A2.[13] Findings derived from Wald tests suggest that the difference is statistically significant (at $p = 5\%$) for capacity and brand.

To conclude, in line with Eq. (2), the findings for the conveyance model generally provide evidence that conveyance affects homeowners' WTP for quality/performance-related attributes. For some attributes (capacity, brand), these effects are stronger if homeowners expect to move within the next two rather than the next five years.

Surprisingly though, the interaction effect for warranty length is not statistically significant: while one could have expected that warranty length could be valued lower because conveyors plan to leave their refrigerator in the house, this is not the case. In addition, and contrary to expectations, we found no evidence that conveyance (in combination with moving plans) affects respondents' WTP for the energy cost of a refrigerator.

4.3.3. Envy-conveyance interaction model

For the *envy-conveyance interaction* model, we are particularly interested in interaction terms between *highenvy*, *convey* and the quality/performance-related attributes. The findings for these three-way interaction terms are reported in Table 4 for the three alternative definitions of conveyors. Results for the means for all variables are reported in Appendix E Table A3. The results we report in Table 4 for the *simple convey* specification suggest that, for envious conveyors, the WTP for warranty, brand, and a 4.5-star rating is lower than that for envious non-conveyors. The coefficients associated with the other attributes exhibit the expected signs but fail to be statistically significant at conventional levels. The findings for the *convey-move5* and the *convey-move2* specification are quite similar, yet the *p*-values associated with the three-way interaction coefficients turn out to be higher than those for the *simple convey* specification. Most likely, this pattern can be explained by differences in the number of observations per group. In the *simple convey* specification, 157 respondents (i.e. 31.1% of the sample) are simultaneously conveyors and of the *highenvy* type. In the *convey-move5* specification, this number drops to 67 (13.3%) while in the *convey-move2* specification it drops to only 36 (7.2%).

We further note that none of the conveyance–attribute interaction terms reported in Appendix E Table A3are statistically significant. Thus, we find no difference in the WTP for these attributes for non-envious conveyors and non-envious non-conveyors. Arguably, this non-result may reflect lack of power. Alternatively, this finding could be explained if conveyance also has positive effects, because it enables moving homeowners to dispose of an old appliance at no cost rather than having to carry it to a waste-disposal site or move it to the new home.

In general, though, the findings for the *envy-conveyance* interaction model provide some evidence that envy reinforces the negative effects of conveyance on product quality/performance, as hypothesized in Eq. (3).

4.3.4. Robustness checks[14]

To assess the sensitivity of our findings, we conducted a number of additional analyses. We organized these robustness checks in the following categories: (i) degrees of freedom and convey–energy cost interaction, (ii) confounding factors, and (iii) moving with and without appliance conveyance.

4.3.4.1. Degrees of freedom and convey-energy cost interaction. Unexpectedly, in the conveyance model the interaction term between *convey* and *energy cost* turned out not to be statistically significant. To test whether lack of degrees of freedom may drive this "no result", we ran the *simple convey*, *convey-move5* and *convey-move2* models while dropping all interactions between *convey* and the quality/performance attributes except for the convey–energy cost interaction. For all three models, the convey–energy cost interaction term was far from becoming statistically significant. Hence, we are confident that lack of power is not driving the "no result" reported in Table 3 for the convey–energy cost interaction term.

4.3.4.2. Confounding factors. It is possible that the findings for the conveyance–attributes interaction terms presented in Table 3 are confounded, i.e. these findings may be driven by differences in other characteristics between conveyors and non-conveyors. To explore this issue, we conducted additional analyses. First, we ran probit models to test via multivariate analyses whether being classified as a conveyor is correlated with socioeconomic characteristics. For the dichotomous dependent variable, we distinguish the three definitions of conveyors: (i) appliances convey, (ii) appliances convey and the household is likely to move within the next five years, and (iii) appliances convey and the household is likely to move within the next two years. For (ii) and (iii) the covariates included gender, respondent age, income, education level, and also envy. For (i), we included dummy variables reflecting plans to move within the next five years and plans to move within the next two years as additional covariates. For all three models, we fail to reject the null hypothesis that all coefficients are zero (against the alternative hypothesis that at least one coefficient is different from zero) at $p = .62$ for (i), $p = .56$ for (ii), and $p = .21$ for (iii).

Second, we estimated the *conveyance model*, where we separately included an additional set of attribute interaction terms with income (dummy = 1 if level of household income exceeds median level of household income) and with education (dummy = 1 if the level of education exceeds the median level of education) as controls in the *convey-move5* and the *convey-move2* models. None of the additional

[13] Differences in significance levels compared with those associated with the models presented in Table 3 probably reflect the lack of statistical power.

[14] Results from all robustness checks which are not shown to save space are available upon request.

interaction terms for income or education turned out to be statistically significant in either of these models (except for the interaction term of brand and education in the convey-move2 model; at $p = .1$).

To summarize, we found no convincing evidence that our results presented for the interaction of attributes and conveyance in Table 3 might be confounded by other factors.

4.3.4.3. Moving with and without appliance conveyance. Individuals planning to move may also not expect to fully recover their investments in high-quality appliances when appliances do not convey. For example, preferences for quality/performance of seller and buyer on the second-hand market may differ. Or, rather than trying to find a buyer on the second-hand market, individuals may decide to dispose of the old appliance because they consider the transaction costs of finding a new buyer prohibitive. To disentangle the effects of conveying movers from those of non-conveying movers, we included an additional vector of interaction terms between the attributes and a dummy variable, *non-convey*. We ran two models, depending on whether respondents planned to move within the next five years or within the next two years. Results for the means of this *conveyance*/*non-conveyance* model appear in Appendix F Table A4. Accordingly, the signs, significance and magnitudes of the interaction terms between *convey* and the quality/performance attributes are very similar to those reported in Table 3.

In addition, similar to the findings for conveying movers, we find that non-conveying movers exhibit a lower WTP for capacity and for 4.5-star rated appliances, and no effect for warranty. Based on Wald tests though, we find no difference for these attributes between conveyers and non-conveyers conditional on moving. Hence, we cannot exclude that our significant findings for the capacity attribute and a 4.5-star rating are driven by moving plans rather than conveyance. Unlike for conveying movers, we find no effect on brand for non-conveying movers. Somewhat surprisingly, our findings suggest that the WTP for lower energy costs is higher for conveying movers.[15]

Finally, we test whether envy is indeed related to conveyance rather than moving. Unless non-conveying movers sell their appliance on the second-hand market, the new homeowner does not benefit at the original owner's expense. In this case, for non-conveying movers, envy should not be related to the WTP for quality/performance appliance attributes. We note that the marginal WTP for a 4.5-star rating in Table A4 for conveyors is statistically significant and of similar magnitude to that for non-conveying movers. We therefore estimated a model similar to the one used for Table A4 for 5-year moving plans, but with two additional interaction terms: convey-move x highenvy x 4.5-star and non-convey-move x highenvy x 4.5-star. We also included interaction terms for highenvy with all attributes. In general, the findings are similar to those presented in Table A4 for the non-conveyance and conveyance with attributes interaction terms. Interestingly though, the WTP estimate for convey-move x highenvy x 4.5-star is statistically significant (at $p < .05$) and takes the value of −217 $, which is close to the value reported in Table A3 (i.e., −253 $). In comparison, the WTP estimate for non-convey-move x highenvy x 4.5-star is positive and not statistically significant. This finding provides supporting evidence for the postulated envy–conveyance mechanism.

5. Conclusion

Conveyance of appliances may keep homeowners from purchasing appliances with costly attributes such as well-known brand name or high energy efficiency because the extra costs cannot be entirely capitalized into the house sales price.

Through a DCE, we tested the effects of conveyance on homeowners' WTP for various refrigerator attributes. Our results provide evidence that conveyance affects appliance attributes: conveyance negatively impacted refrigerator brand and customer ratings, and, as also noted by Sandler (2018), it leads to the purchase of smaller refrigerators. Conveyors (homeowners planning to move and to leave their refrigerator in a dwelling when moving) appear therefore more likely to purchase a smaller refrigerator, from a less well-known brand, and with lower customer ratings. We find that the effects of conveyance on size and brand are more pronounced when conveyors expect to move in the shorter run, thus shortening the duration of ownership and leaving less time to enjoy the benefits of the high quality/performance appliance attributes.

Interestingly, we find no evidence that conveyance directly affects the choice of energy-efficient appliances: the interaction terms for conveyance and energy cost were not statistically significant. Of course, homeowners may incidentally purchase less energy-efficient appliances (even without paying attention to energy consumption) through the purchase of lower quality/performance appliances. Yet, as in Sandler (2018), this effect on energy consumption may be compensated by conveyors' choice of smaller refrigerators, which typically consume less energy than larger ones. It is therefore not entirely clear how, if at all, conveyance affects adoption of energy-efficient appliances and future research should investigate the effects in more detail. Moreover, our findings are consistent with the caveat suggested by Faure and Schleich (2020), who acknowledge that their findings pertaining to the negative effects of conveyance on appliance energy performance in their survey of households in Spain may not be causal, but rather may stem from the fact that more energy-efficient appliances are of higher quality or perform better than less energy-efficient appliances. In addition, preferences for energy costs may differ across countries, or households in Spain may value electricity costs more highly than in the U.S., because these costs account for a higher share of disposable income.

So far, social preferences such as envy have not received much attention when studying the adoption of energy-efficient technologies. Our results suggest that such preferences may play a role in explaining preferences for certain attributes when appliances convey. In particular, the effects of conveyance on purchase are generally reinforced by envy: envious conveyors prefer to purchase a refrigerator from a less well-known brand, with lower customer ratings (and also with a shorter warranty period) than non-envious conveyors. However, our results provide no evidence that conveyance prompts envious homeowners to purchase less energy-efficient appliances.

To summarize, our findings suggest that conveyance and its interaction with envy help explain the quality/performance attributes of appliances that homeowners choose. In contrast, our findings provide no evidence that these factors help to explain the energy-efficiency paradox.

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[15] We conducted Wald tests to test for differences in the WTP for the quality/performance attributes between conveying movers and non-conveying movers. Using information indicating whether respondents planned to move within the next five (two) years to define conveyors and non-conveyors, the results suggest that the differences for capacity, brand, and energy costs (brand and energy costs) are statistically significant at the 5% (10%) level.

Appendix A. Typical choice card

Fig. A1. Typical choice card.

Appendix B. Instructions for envy game

One out of every 100 survey participants will be selected at random to receive an additional amount between $0 and $100. The exact amount will be determined by another randomly selected participant who will not receive this additional payment him- or herself.
In other words, you could be selected to win an additional amount or be selected to determine the amount that another participant will receive.
Please indicate how much another participant should receive in case that you are selected to determine this amount.
(Please note that your answer to this question is **binding and anonymous.** If you are selected, the amount you chose in this question will automatically be paid to another participant. Your own payment for participation in this study will not be affected by your decision.)
The amount in $ that another participant should receive if you are selected at random to determine this amount. (0—100).

Appendix C. Results for conveyance models - standard deviations

Table A1
Mixed logit model results in WTP space for base model and conveyance model (robust standard errors in parentheses) - Standard deviations.

	Base	Conveyance model		
		Simple convey	Convey-move5	Convey-move2
Price	0.89***	0.81***	0.85***	0.83***
	(0.15)	(0.13)	(0.14)	(0.13)
Energy cost	−2.27	1.56	−1.48	1.31
	(1.75)	(2.29)	(2.36)	(1.74)
Capacity	−50.79***	−52.31***	−51.21***	−52.12***
	(4.55)	(4.62)	(4.73)	(4.52)
Warranty	−57.67***	−51.81***	−58.26***	−51.69***
	(9.44)	(17.26)	(9.82)	(14.91)
Brand	233.34***	−217.54***	242.92***	−207.86***
	(34.27)	(48.15)	(35.31)	(42.84)
2.5 stars	352.88***	348.56***	355.13***	343.72***
	(44.60)	(43.64)	(45.35)	(40.46)
4.5 stars	53.19	31.90	62.34	13.85
	(52.95)	(131.36)	(59.97)	(98.21)
N	8048	8048	8048	8048

* $p < .10$.
** $p < .05$.
*** $p < .01$.

Appendix D. Results for conveyance model with different moving times[16]

Table A2
Mixed logit model results in WTP space for conveyance model with interaction terms for varying moving times (robust standard errors in parentheses) - Means.

Price	−5.89***
	(0.09)
Energy cost	−8.00***
	(0.91)
Capacity	62.09***
	(4.32)
Warranty	57.19***
	(8.24)
Brand	205.75***
	(26.37)
2.5 stars	−469.46***
	(29.77)
4.5 stars	221.05***
	(34.45)
ConveyM5† × energy cost	0.56
	(2.09)
ConveyM5 × capacity	10.68
	(10.19)
ConveyM5 × warranty	7.67
	(20.36)
ConveyM5 × brand	12.47
	(59.04)
ConveyM5 × star4.5	−76.08
	(69.88)
ConveyM2‡ × energy cost	−1.53
	(2.86)
ConveyM2 × capacity	−31.43**
	(13.83)
ConveyM2 × warranty	−11.14
	(25.00)
ConveyM2 × brand	−240.62***
	(77.52)
ConveyM2 × star4.5	−62.15
	(89.60)
Log likelihood	−2140.7536
N	8048

* $p < .10$.
** $p < .05$.
*** $p < .01$.
† Conveyors planning to move within the next five years.
‡ Conveyors planning to move within the next two years.

Appendix E. Results for conveyance-envy interaction model

Table A3
Mixed logit model results in WTP space for conveyance-envy-interaction model (robust standard errors in parentheses) - Means.

[16] To save space, we do not report results for standard deviations in Appendices D, E, and F. These results are available upon request.

	Envy-conveyance interaction model		
	Simple convey	Convey-move5	Convey-move2
Price	−5.89***	−5.86***	−5.90***
	(0.09)	(0.09)	(0.09)
Energy cost	−9.87***	−8.37***	−8.12***
	(1.76)	(1.25)	(1.18)
Capacity	67.05***	68.16***	70.74***
	(8.74)	(5.92)	(5.82)
Warranty	37.15**	48.44***	53.24***
	(15.09)	(10.78)	(9.82)
Brand	163.11***	158.57***	175.53***
	(43.38)	(35.21)	(32.47)
2.5 stars	−378.29***	−426.07***	−461.60***
	(62.29)	(44.95)	(43.20)
4.5 stars	190.94***	219.05***	215.72***
	(54.04)	(44.52)	(42.44)
Convey × energy cost	2.75	−0.35	−2.33
	(2.28)	(2.53)	(3.43)
Convey × capacity	3.90	−2.71	−12.82
	(11.43)	(13.40)	(14.11)
Convey × warranty	31.38	14.11	−3.79
	(19.54)	(23.89)	(27.87)
Convey × brand	−7.26	7.26	−156.09*
	(57.56)	(82.70)	(89.61)
Convey × star2.5	−131.96	−91.60	132.62
	(81.34)	(100.29)	(129.96)
Convey × star4.5	51.26	0.63	24.49
	(67.71)	(90.09)	(98.90)
Highenvy_ecost	2.04	0.52	0.43
	(2.63)	(1.79)	(1.64)
Highenvy_cap	−17.10	−18.97**	−14.40*
	(13.55)	(8.28)	(8.72)
Highenvy_warranty	39.70*	26.23*	14.31
	(23.38)	(15.30)	(15.14)
Highenvy_brand	129.64*	97.33*	62.18
	(71.49)	(51.38)	(49.30)
Highenvy_star2.5	60.72	−4.65	−30.07
	(77.92)	(60.31)	(55.91)
Highenvy_star4.5	−101.35	−57.08	−27.23
	(101.39)	(65.30)	(65.09)
Convey × highenvy × energy cost	−2.56	0.30	2.33
	(3.33)	(3.46)	(4.76)
Convey × highenvy × capacity	0.65	2.73	−16.83
	(16.81)	(17.84)	(21.24)
Convey × highenvy × warranty	−44.00	−46.13	−5.49
	(29.04)	(31.44)	(38.92)
Convey × highenvy × brand	−150.38*	−189.96*	−123.71
	(89.09)	(104.93)	(132.23)
Convey × highenvy × star2.5	139.03	54.48	−180.68
	(126.53)	(135.53)	(188.69)
Convey × highenvy × star4.5	−218.57**	−252.78**	−244.27*
	(99.22)	(121.52)	(140.21)
Loglikelihood	−2136.1832	−2134.9359	−2134.891
N	8048	8048	8048

* $p < .10$.
** $p < .05$.
*** $p < .01$.

Appendix F. Results for robustness checks

Table A4
Mixed logit model results in WTP space for conveyance/non-conveyance model with additional interaction terms for moving non-conveyors (robust standard errors in parentheses) - Means.

	Conveyance/non-conveyance model	
	move5	move2

(continued on next page)

Table A4 (*continued*)

	Conveyance/non-conveyance model	
	move5	move2
Price	-5.83^{***}	-5.88^{***}
	(0.10)	(0.10)
Energy cost	-6.98^{***}	-7.50^{***}
	(1.02)	(0.92)
Capacity	64.74^{***}	66.65^{***}
	(4.76)	(4.37)
Warranty	60.56^{***}	57.13^{***}
	(8.44)	(8.04)
Brand	190.84^{***}	211.10^{***}
	(28.97)	(25.02)
2.5 stars	-460.10^{***}	-473.62^{***}
	(30.28)	(31.45)
4.5 stars	237.50^{***}	215.59^{***}
	(36.78)	(32.83)
Convey-move × energy cost	−1.54	−1.40
	(1.75)	(2.37)
Convey-move × capacity	−8.49	-25.61^{**}
	(8.66)	(11.60)
Convey-move × warranty	−5.70	−3.91
	(15.33)	(19.38)
Convey-move × brand	-92.16^{*}	-233.00^{***}
	(50.40)	(63.92)
Convey-move × star4.5	-166.43^{***}	-134.20^{*}
	(58.27)	(69.28)
Non-convey-move × energy cost	-6.38^{***}	-7.96^{**}
	(2.19)	(3.33)
Non-convey-move × capacity	-28.25^{**}	-47.17^{***}
	(11.69)	(17.00)
Non-convey-move × warranty	10.29	48.97
	(22.73)	(31.28)
Non-convey-move × brand	62.44	−14.08
	(62.64)	(100.46)
Non-convey-move × star4.5	-160.67^{**}	-223.48^{**}
	(72.58)	(102.27)
Log likelihood	−2138.499	−2133.003
N	8048	8048

* $p < .10$.
** $p < .05$.
*** $p < .01$.

Appendix G. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.eneco.2020.104816.

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