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Measuring the surplus of superficiality: the case of dented bumper repair

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This article uses data from a survey administered to 400 automobile owners in northern Utah to estimate willingness-to-pay (WTP) for removal of a superficial dent in the bumper of a typical owner's vehicle. A unique set of controls are used to estimate the determinants of WTP for this particular manifestation of superficiality. Both parametric and nonparametric measures of mean WTP are also derived. To the extent that a driver's demand for superficiality represents a market failure, e.g., due to imperfect information, or, in a normative sense, the influence of wasteful social norms, our welfare measures represent estimates of the potential social deadweight loss associated with the purchase of this particular good. In this case, potential social deadweight loss is defined as total surplus from the market for dented-bumper repair that remains 'untransferred' to markets for non-(or less)superficial goods. Best-guess estimates of the annual potential deadweight loss from dented-bumper repair in the US fall in the range of $122 000 to $609 000, depending upon the estimated number of superficially dented bumpers per year.

Keywords: superficiality; willingness-to-pay; deadweight loss

JEL Classification: C2; Z1

I. Introduction

This article demonstrates how to empirically measure the economic consequences of a universal human foible: superficiality. Superficiality is defined as '[a condition] of little substance or significance; trivial' (Collins English Dictionary, 2003). As we show in this article, the behaviour implied by superficiality's definition is amenable to empirical investigation in a market where potential confounding factors are limited and relatively easy to control for. Our controls – obtained from a survey administered to 400 automobile owners in Northern Utah – enable us to estimate the determinants of willingness-to-pay (WTP) for the immediate removal of a superficial dent from a car's bumper.[1]

[1] The full text of the WTP question accompanying the photograph reads, 'Please begin this survey by viewing the photograph of the dented bumper. Note that only the bumper has been dented. Nothing else about the vehicle has been affected. Now, suppose when you return to your own car in the parking lot outside this building, you notice a dent has been left on its bumper, identical to the one you've just viewed in the photograph. You immediately file a claim with your auto insurance company for the damage to your bumper and the company sends you a check (made out to you) for **$XX**, which is exactly the amount needed to repair the dent. The insurance company informs you that you are not required to use the money to fix the dent – you can spend it however you wish, no questions asked. Which statement below do you think best describes what you will choose to do with the money? (*If you did not drive your car to this building this morning/afternoon, please think of the car you normally drive for commuting purposes around town.*)'

Table 1. Variable definitions and descriptive statistics

Variable	Variable definition	Mean (SD)
superficial	=1 if individual repairs bumper within a week or two, =2 if repaired after one or 2 weeks but within the year, =3 if repaired after 1 year but before car is sold, =4 if uncertain whether bumper will ever be repaired, =5 if bumper will never be repaired.	1.70 (1.30)
bid	$t_i \in$ {$200, $300, $400, $500, $600}	398.20 (142.05)
certain	Degree of certainty associated with answer to superficial question (%)	0.85 (0.21)
vyear	Model year of personal vehicle with imagined dent in rear bumper	2002.57 (6.47)
yrswillown	Number of years owner expects to continuing owning the vehicle	3.05 (0.91)
resale	Extent to which owner is concerned about vehicle's resale value (=0 if 'unconcerned',..., =1 if 'very concerned')	0.53 (0.34)
livelihood	Extent to which vehicle is important for owner's livelihood (=0 if 'unimportant',..., =1 if 'very important')	0.44 (0.36)
gender	=1 if male, 0 if female	0.57 (0.50)
lowinc	=1 if household income is ≤$50 000, 0 otherwise	0.45 (0.50)
midinc	=1 if household income in interval $50 001–$100 000, 0 otherwise	0.35 (0.48)
highinc	=1 if household income is >$100 000, 0 otherwise	0.16 (0.36)
young	=1 if individual's age is 18–25 years, 0 otherwise	0.30 (0.46)
middle	=1 if individual's age is 26–55 years, 0 otherwise	0.47 (0.50)
old	=1 if individual's age is greater than 55 years, 0 otherwise	0.23 (0.42)

Using an ordered logit model to explain variation in an individual's 'degree of superficiality', which in this study is represented by how soon after incurring a superficial dent in his car's bumper the automobile owner would have it repaired, we find that a higher bid level (i.e. direct cash payment from the insurance company to the owner) as well as being middle-aged and in the low-income bracket reduces the probability that an individual will have the dented bumper repaired immediately, all else equal. To the contrary, increases in (1) the model year of the vehicle, (2) the number of years the vehicle is expected to be owned, (3) the individual's concern for resale value and (4) the extent to which the vehicle is considered important for the individual's livelihood each increase the probability that an individual will have the dented bumper repaired immediately. Our best-guess estimate of mean WTP for immediate dented-bumper repair is $355. Under the assumption of normally distributed predicted WTPs across all individuals, this results in an estimated annual potential social deadweight loss of immediate repair of between $122 000 and $609 000, depending upon the estimated number of superficially dented bumpers per year.

II. The Survey, Variable Definitions and Descriptive Statistics

We conducted face-to-face surveys during the months of October 2012 to January 2013 in the lobby of the Cache County Building, located in Logan, Utah. A total of 389 automobile owners completed the survey, while 569 owners refused to participate (resulting in a response rate of 38.5%).[2] Prior to its administration to the public, the survey instrument underwent two rounds of pre-testing in the form of cognitive interviews (Beatty and Willis, 2007).[3]

Definitions and descriptive statistics for the key survey variables are provided in Table 1. We note that the majority of our sample indicated a preference for repairing the imagined dent in their vehicle's rear bumper immediately, i.e. within 2 weeks of its occurrence (based on the relatively low mean value of 1.70 for variable *superficial*). Indeed, approximately 73% of the survey's respondents indicated a preference for immediate repair. With respect to being concerned about their vehicle's resale value (*resale*), the average individual in our sample was roughly in the middle between being 'unconcerned' and 'very concerned' (thus, we might label the average individual as being 'somewhat concerned' about the resale value of their vehicle). The average individual was less in the middle when it comes to evaluating the vehicle's importance to his livelihood (*livelihood*), seeing the vehicle with the imagined dent as closer to being 'unimportant' than 'very important'.

III. Empirical Results

Given the ordinal nature of our response variable, *superficial*, we estimate an ordinal regression model (ORM) following McKelvey and Zavoina (1975), Greene and Hensher (2010) and Long and Freese (2006). Table 2

[2] Our response rate is slightly lower than the typical, or average, rate for these types of surveys (de Leeuw, 1992).
[3] The survey instrument is available upon request from the author.

Table 2. Individual effects for ordered and generalized-ordered logit models (OLM and GOLM) explaining *superficial*[a]

	OLM			GOLM[e]	
Explanatory variable[b]	Raw coefficient[c]	% Change in odds	Marginal effect[d]	Raw coefficient[c]	Marginal effect[d]
bid	0.002* (0.001)	0.20	−0.0002* (0.00015)	0.004*** (0.001)	−0.0006*** (0.00015)
vyear	−0.060** (0.023)	−5.6	0.010** (0.004)	−0.060** (0.024)	0.009** (0.004)
yrswillown	−0.368** (0.162)	−30.8	0.060** (0.026)	−0.387** (0.157)	0.057** (0.023)
resale	−1.958*** (0.449)	−85.9	0.321*** (0.071)	−1.660*** (0.438)	0.244*** (0.062)
livelihood	−1.147*** (0.423)	−68.2	0.188*** (0.071)	−0.666* (0.377)	0.098* (0.056)
gender	0.036 (0.264)	3.7	−0.006 (0.043)	—	—
young	0.697 (0.525)	100.9	−0.124 (0.099)	—	—
middle	1.223*** (0.477)	239.6	−0.204*** (0.078)	0.416 (0.273)	−0.062 (0.041)
lowinc	0.651* (0.392)	91.7	−0.109* (0.065)	0.649** (0.285)	−0.097** (0.043)
midinc	0.383 (0.430)	46.7	−0.065 (0.075)	—	—
constant	—	—	—	118.33** (49.97)	—
Cut Point 1	−115.10*** (45.53)	—	—	—	—
Cut Point 2	−114.50*** (45.54)	—	—	—	—
Cut Point 3	−114.34** (45.53)	—	—	—	—
Cut Point 4	−113.01** (45.54)	—	—	—	—
Summary statistic					
N[f]	354	—	—	358	—
Log likelihood	−274.72	—	—	−239.80	—
Wald χ^2[g]	91.34***	—	—	145.13***	—
McFadden's R^2	0.146	—	—	0.268	—
McKelvey and Zavoina's R^2	0.339	—	—	—	—

Notes: [a]White (1982) robust SE in parentheses. [b]Estimated cutpoints on latent measure of *superficial* used to differentiate superficial = *j*− *1* from superficial = *j* (i.e. cutpoint *j*), *j* = *1,...,5*, when values of remaining explanatory variables are evaluated at 0. Respective Wald χ^2 tests have rejected null hypotheses (at 1% levels of significance) that adjacent cutpoints are equivalent. [c]The raw coefficient value measures the change in log odds. [d]Marginal effects are calculated with respect to an increase in the probability that the average individual will choose superficial = *1*. [e]Since variables *gender*, *young* and *midinc* were found to be statistically insignificant in the OLM, they were removed from estimation of the GOLM in order to facilitate convergence of that model. [f]35 and 31 surveys, respectively, were determined to be unusable for OLM and GOLM analysis due to missing information. [g]10 and 28 coefficients, respectively, are tested in the OLM and GOLM. ***Significant at the 1% level, **significant at the 5% level and *significant at the 10% level (for two-tailed tests).

provides coefficient estimates for the explanatory variables included our ordered-logit and generalized-ordered-logit models (OLM and GOLM, respectively) that explain variation in *superficial* for the average survey respondent. Since the empirical results for the OLM and GOLM are qualitatively very similar, we refer to the OLM results in what follows.

Raw coefficient estimates and their corresponding percentage-change-in-odds for the OLM are presented in columns 2 and 3 of Table 2, respectively. As indicated, for a 1-dollar increase in the randomized bid level, we expect a 0.002 increase in the log odds (or 20% increase in the odds) of the average individual choosing a higher level of *superficial*, i.e., of being less likely to repair the dented bumper immediately, all else equal. Similarly, being middle-aged and in the lowest income bracket increases the log odds(odds) of repairing the dented bumper later by approximately 1.22(240%) and 0.65(92%), respectively, all else equal.

To the contrary, the log odds(odds) that the average individual will repair his bumper later decreases by approximately (1) 0.06(6%) with a 1-year increase in the vehicle's model year, (2) 0.37(31%) with a 1-year increase in the number of years the vehicle is expected to be owned, (3) 1.96(86%) with a 1-unit increase in the individual's concern for the resale value of his car and (4) 1.15(68%) with a 1-unit increase in the extent to which the vehicle is important for the individual's livelihood. Associated marginal effects for the OLM are presented in column 4 of Table 2. These estimates concur with their corresponding raw coefficient estimates. For example, a 1-dollar increase in the average bid value (of approximately $400; see Table 1) reduces the probability by 0.03% that the average individual will repair his dented bumper immediately. Remaining marginal effects are interpreted accordingly.

With respect to goodness-of-fit measures for the OLM, the Wald χ^2 statistic of 91.34 indicates that we can safely reject the null model with no predictors (at 1% level of significance). Roughly speaking, McKelvey and Zavoina's R^2 indicates that approximately 34% of the total variation in the latent response underlying *superficial* is explained by the set of explanatory variables included in the OLM. Further,

Table 3. Sample relative frequencies versus predicted mean probabilities for *superficial*

Superficial	Relative frequencies	Predicted mean probabilities	
		OLM	GOLM
1	72.83	72.77	76.62
2	8.15	8.28	9.09
3	1.63	1.82	−18.74
4	10.87	10.88	20.42
5	6.52	6.25	12.61

as Table 3 shows, the sample's relative frequencies for *superficial*'s five response categories compare favourably with the OLM's (and to some extent with the GOLM's) respective predicted mean probabilities for each category.

We adopt a parametric and a nonparametric approach to estimating mean WTP for dented-bumper repair. For both approaches, we first convert *superficial* to a binary variable, which we label *supbinary* (supbinary = 1 if superficial = 1, otherwise supbinary = 0). Therefore, both welfare measures represent mean WTP for immediate bumper repair (which in turn represents what might be considered WTP for the most extreme form of superficiality in our model). For the parametric approach, we apply Cameron's (1988) censored logistic method of estimating mean WTP using *supbinary* as our (effective) dependent variable. The associated 95% confidence interval for our mean estimate is calculated using the Krinsky and Robb (1986) method. For the nonparametric approach, we calculate a (lower-bound) Turnbull estimate of mean WTP following Kriström (1990) and Boman *et al*. (1999). Table 4 presents our parametric and nonparametric mean WTP estimates (WTP1 and WTP2, respectively).[4]

As indicated in Table 4, WTP1 is roughly three times as high as WTP2.[5] Both estimates are statistically significantly different than zero at the 1% level. As pointed out by Kriström (1997) and Haab and McConnell (1997, 2002), the Turnbull estimate is resistant to problems that typically plague mean welfare measures calculated with low degrees of freedom from the censored logistic model.

Table 4. Mean WTP estimates for superficiality[a]

WTP1[b]	1025.52*** (682.71, 3284.67)
WTP2[c]	355.23*** (353.88, 356.58)

Notes: [a]WTP values are in US$. [b]Krinsky and Robb (1986) 95% confidence intervals (based on 500 bootstrap replications) are reported in the parentheses, with an achieved significance level of 1% (as denoted by ***). [c]95% confidence intervals (based on assumed *t*-distribution) are reported in parentheses, with an achieved significance level of 1% (as denoted by ***).

We therefore consider the Turnbull measure to be our most reliable point estimate.

IV. Estimates of the Potential Social Deadweight Loss of Dented-Bumper Repair

To derive an estimate of the potential social deadweight loss for dented-bumper repair in the US (which is based on the assumption of normally distributed predicted WTPs), we require an estimate of the aggregate number of dented bumpers repaired annually. The US National Highway Safety Traffic Administration (NHSTA) publishes information on 'crashes by crash severity' each year. The crash categories are 'fatal', 'nonfatal injury' and 'property damage only'. In 2009 (the most recent year data is available), an estimated 3957 property-damage-only crash incidents (representing roughly 72% of all reported incidents) were reported nationwide (NHSTA, 2013). For our analysis, we assume that 15%, 25%, 35%, 50% and 75% of these roughly 4000 incidents, respectively, involved dented bumpers of the type we have labelled 'superficial' in this study, i.e. the total number of superficially dented bumpers in the US is assumed to be 600, 1000, 1400, 2000 or 3000 per year.

Next, we add respective estimates of the average repair shop's profit per dented bumper to our mean WTP estimate and then subtract from these sums the corresponding total costs of repairing the dented bumper. This results in a set of estimates of the total surplus per repaired bumper. Toward this end, Body Shop Business (2013) estimates that the average gross profit margin in the US per 'paintless dented-bumper repair' is 50–75%. If we therefore assume a profit margin of the average of this range, 62%, then we obtain the respective ranges of estimated total surplus per repaired bumper presented in Table 5 based on WTP1 and WTP2 and the range of costs per bumper (as represented by

Table 5. Estimates of total surplus per repaired bumper by bid level

bid levels	Total surplus/repaired bumper	
	WTP1	WTP2
200	950	279
300	912	241
400	874	203
500	836	165
600	798	127
Mean value	874	203

Note: All values are in US$, rounded to the nearest $1.

[4] Output for the censored logit regression estimated in Stata/IC 11.0 for Windows (32 bit), as well as for the parametric and Turnbull mean WTP estimates, is available upon request from the author.
[5] The upper-bound Turnbull estimate of mean WTP is approximately $1307, which is very close to our parametric estimate.

Table 6. Estimates of potential deadweight loss of superficiality (total surplus) based on parametric (WTP1) and non-parametric (WTP2) estimates.

	Total surplus	
Number of dented bumper repairs	WTP1	WTP2
600	524 000	122 000
1000	874 000	203 000
1400	1 224 000	284 000
2000	1 748 000	406 000
3000	2 622 000	609 000

Note: All values are in US$, rounded to the nearest $1000.

the range of *bid* levels presented in Table 1). As indicated, the averages of these ranges are $874 and $203, respectively.

Multiplying these average total surplus estimates by the respective numbers of dented-bumper repairs results in our corresponding estimates of potential social deadweight loss, which range from $122 000 (based on WTP2) to $2 622 000 (based on WTP1), as reported in Table 6.

V. Conclusions

This article has demonstrated how the potential deadweight loss of superficiality – in the form of dented-bumper repair – might best be measured. As we have shown, its measurement is based on (or perhaps more accurately stated, constrained by) three factors. First, as the word 'potential' indicates, the analysis is partial-equilibrium in nature. It measures solely the surplus that remains 'untransferred' to markets for nonsuperficial goods, rather than what would be the transfer's general-equilibrium, net social benefit as these nonsuperficial markets expand over time. Second, the analysis is premised upon the belief that dented-bumper repair indeed aligns closely with the dictionary definition of superficiality, which again is '[a condition] of little substance or significance; trivial' (Collins English Dictionary, 2003). As discussed in Section I, the type of dented-bumper survey participants have been asked to value in this study seems to fit this definition in a fairly broad sense. Third, key control variables have been included in the regression analysis in order to mitigate the possibility that estimates of an individual's 'degree of superficiality' and his WTP for superficiality (in terms of how quickly the bumper is repaired) are confounded with other concerns, such as with the automobile's resale value and its perceived importance to the owner's livelihood. In the end, our best-guess mean WTP estimate for immediate dented-bumper repair is $355. This results in an annual potential social deadweight loss of between $122 000 and $609 000, depending upon the estimated number of superficially dented bumpers per year.

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