What Drives Dairy Farmer Antibiotic Treatment Decisions?

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Motivation

In light of concerns about resistance development in antibiotics for human use, regulations on antibiotics in animal agriculture have expanded over the past decade. The main purpose of antibiotics use in dairying is to cure mastitis, i.e., to restore milk yield and quality through eliminating bacterial infection of mammary tissue.

Our interest is in the managerial economics of farm-level antibiotics choices. Humans are prone to many decision-making biases, including status quo bias, endowment effects and loss aversion (Just 2014). Agricultural decision-makers may, through rational inattention or irrationality, systematically mismanage their inputs (e.g., Perry et al. 2017).

Our research seeks to understand whether behavioral economics approaches might be used to reduce demand for antibiotics on dairy farms. We will do so by considering who makes most extensive use of these inputs and also by looking at the cognitive processes employed when making these decisions.

Survey and Conceptual Model

Through the late spring and summer of 2017 paper and web surveys were sent to dairy farmers in Wisconsin, Minnesota and Michigan requesting information on their views about business conditions and investment intentions as well as standard information about demographics, operation scale and product markets.

A section was included that asked these growers about whether and how antibiotics input choices were made on the farm, as well as anticipated cost and revenue implications. In it we solicit information on the presence of formalized protocols for administration, whether records are kept regarding a cow's mastitis history, mastitis management practices and risk attitudes.

One question asked respondents to consider a stylized decision environment. For this question four contexts were provided where in each two parameters were filled in, these being 'the probability a single cow can be cured by use of antibiotics' and 'the reduction in loss if the cow can be cured'. Subjects were asked to provide the greatest cost they would be willing to pay (WTP) to treat the animal.

Four versions were sent out differing only in this question and using a Latin square design. We received a total of 688 responses, of which about 480 completed the WTP queries. Responses were spread quite evenly across the four versions of the question.

Letting P = probability of cure and L = reduction in loss then expected reduction in loss amounts to P×L. In classic model, WTP= P×L

Data

Information on 16 different (probability, avoided loss) combinations are available.

Table 1: Mean WTP to Treat Animal with Antibiotics

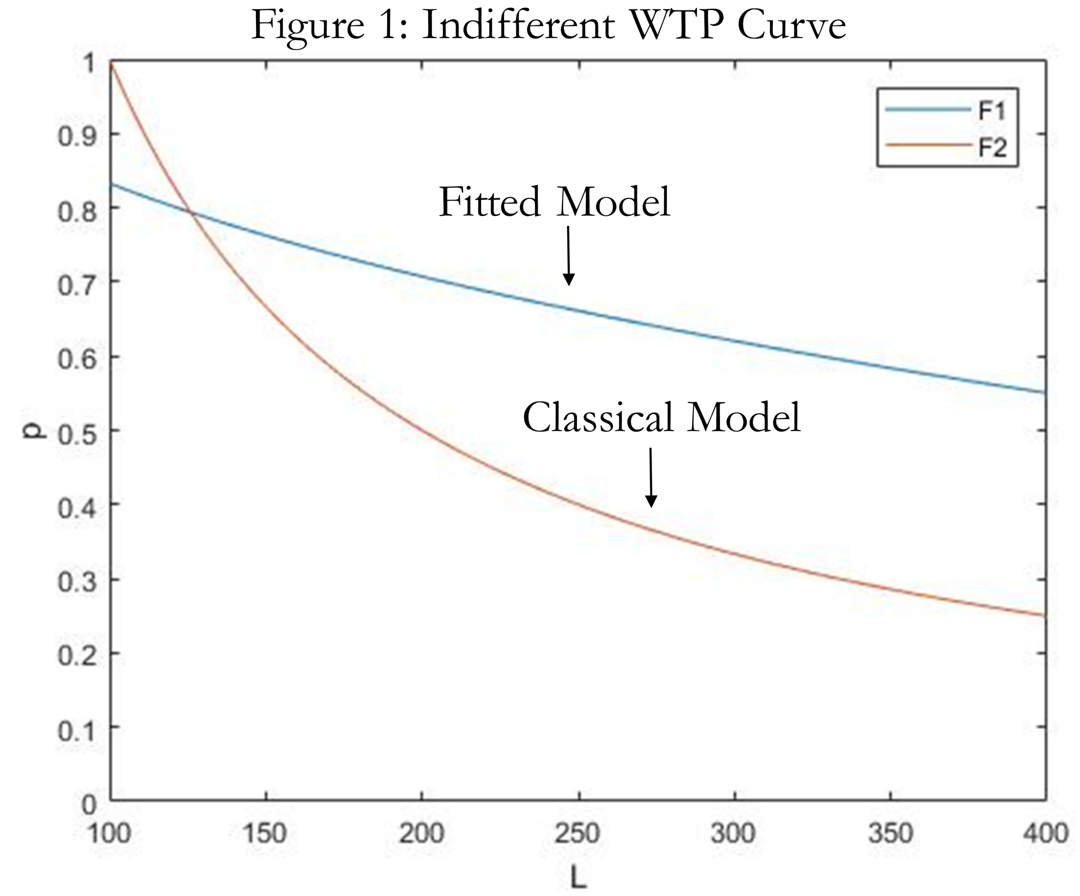
		L			
		$100	$150	$200	$250
p	0.4	$105	$127	$120	$110
	0.55	$138	$134	$130	$142
	0.7	$156	$159	$170	$196
	0.85	$175	$176	$196	$200

Our interest is in how willingness to pay, WTP, compares with P×L and with each product component.

Descriptive Analysis

Several observations are apparent from table 1. Moving across columns, mean WTP exceeds expected loss, P×L, for low loss contexts but approximately equals expected loss for higher loss contexts. This finding appears to be consistent with the "diminishing sensitivity" principle, a feature of prospect theory(Tversky, A., & Kahneman, D. 1991). Furthermore, the mean WTP expresses limited response to loss. Moving down columns, mean WTP exceeds expected loss for low probability contexts but approximately equals expected loss for higher probability contexts while they express strong sensitivity to probability. It would appear that respondents find probability to be more salient than loss at issue. Figure 1 shows that actual WTP is more sensitive to probability where F1 is based on theoretic model WTP= P×L and F2 is WTP fitted as second-order expansion in P and L.

Figure 1: Indifferent WTP Curve



Results

Table 2: OLS Regression for WTP to Treat Animal with Antibiotics

P	118.526**	
	-2.13	
L	-0.043	
	(-0.22)	
P × L	0.248	0.473***
	-0.82	-7.45
Herdsize	-1.403**	-1.381**
	(-2.17)	(-2.12)
Herdsize^2	0.0022*	0.0021
	-1.65	-1.58
Other control variables	YES	YES
Constant	125.70**	166.95***
	-2.15	-3.56
Observations	1,665	1,665
R-squared	0.089	0.07

* p<0.1 ** p<0.05 *** p<0.01

References

Just DR. 2014. Introduction to Behavioral Economics. Wiley.

Perry E et al. 2017. Product formulation and glyphosate application rates: confusion or rational behavior? Selected paper, AAEA Annual Meetings, Chicago, IL.

Tversky, A., & Kahneman, D. 1991. Loss aversion in riskless choice: A reference-dependent model. The Quarterly Journal of Economics, 106(4), 1039-1061.

Discussion

Regression estimates confirm that WTP declines somewhat for larger enterprises and for full-time farmers. Sensitivity of WTP to expected loss is about 50%, while WTP is more probability sensitive than loss sensitive. The survey also asked directly for a ranking of most and least important factors in regard to managing mastitis. Table 3 reports the rankings, and corroborates the WTP analysis that probability is the variable that managers focus on.

Table 3: The Most and Least Important factor in Mastitis Management

	Most important	Least important
Increasing the probability that the treatment is successful	60.33%	13.12%
Managing the cost of treatment	6.82%	63.54%
Reducing the loss if the cow is infected and the treatment is effective	32.85%	23.33%
Total	484	480

Turning to managing on-farm antibiotics demand from the social welfare perspective, our results suggest that research and outreach efforts and practical tools which seek to better inform growers on infection probability will be more effective than those that address loss (e.g., more stringent rules about milk withdrawal from market after treatment) or emphasize cost, perhaps through user fees as currently implemented in several European countries. An inquiry into why dairy farmers emphasize probability of loss over amount at stake is warranted.

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