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FEEDER CATTLE GENOMIC TESTS: ANALYZING CATTLE PRODUCER ADOPTION DECISIONS[1]

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INTRODUCTION

Feeder cattle genomic tests (GTs) are a tool producers can use when making feeder cattle marketing and heifer retention decisions based on the expected performance of cattle in the feedlot or as replacement females. For example, Neogen's Igenity Feeder Cattle Test estimates growth and carcass characteristics of cattle through its Igenity Terminal Index (ITI) (Neogen 2022). The index is calculated using the predicted genetic values of hot carcass weight, ribeye area, marbling, tenderness, fat thickness, residual feed intake and calving ease direct. Similarly, Zoetis offers the Inherit Select Heifer Selection Tool (Zoetis 2022), which provides genomic expected progeny differences (EPDs) for 18 traits and five economic indexes.

Cattle producers have used expected progeny differences (EPDs) for years as part of their sire selection criteria. Following recent developments in high-density genotyping technologies, many producers have instituted the use of genomic enhanced EPDs in sire selection, especially for unproven sires with few or no offspring. Alternatively, it appears there has been limited commercial use of GTs for feeder cattle and replacement heifers and even less research evaluating their use.

A few studies have estimated the value of certain genetic markers or characteristics to market feeder and feedlot cattle, but the cost of the test was found to be greater than the estimated benefits (DeVuyst, et al. 2007; Lusk 2007; Thompson, et al. 2016). Alternatively, Thompson et al. (2017) found genetic testing a sample of cattle resulted in GTs benefits exceeding the cost of the test. Furthermore, the cost of GTs has declined (Neogen 2020). Thus, there is reason to evaluate GT benefits given the lower cost of using them.

The goal of this publication is to report on research findings concerning Tennessee cattle producer preferences for GTs. Specifically, the following were evaluated (1) feeder cattle and replacement heifer producers' interest in using GTs, (2) producer willingness to pay (WTP) for these tests, (3) the percentage of cattle they would test and (4) how producer and farm characteristics affect producers' GTs adoption decisions when marketing feeder cattle and selecting replacement heifers.

METHODS

To answer these research goals, an online survey was administered in June 2020 to Tennessee cattle producers who had participated in the Tennessee Agricultural Enhancement Program. This is the first known study to survey cattle producers concerning the use of feeder cattle GTs for marketing feeder cattle and retaining replacement heifers. This study will contribute to understanding producer interest and use of GTs, as well as assessing if the perceived value of these tests (WTP) is greater than current costs, which should be useful to companies selling GTs and producers considering their use.

[1]Adapted from DeLong, K. L., K. L. Jensen, C. N. Boyer, A. P. Griffith, and C. Martinez. Feeder cattle genomic tests: Analyzing cattle producer adoption decisions. Accepted and forthcoming. Journal of the Agricultural and Applied Economics Association. https://doi.org/10.1002/jaa2.61

[2]The Tennessee Agricultural Enhancement Program is a cost share program focusing primarily on long-term investments including hay storage, livestock working facilities, genetics and animal health for cattle producers. Additional information can be found at https://www.tn.gov/agriculture/farms/taep.html

RESULTS AND DISCUSSION

About 56 percent of the producers who completed the survey were interested in using GTs to market feeder steers and heifers, while a little over 74 percent were interested in using the test for replacement heifer decisions (Table 1). For the producers who were interested in using GTs, the WTP averaged $20.77/head for marketing feeder cattle and $22.83/head for replacement heifer decisions. Figure 1 graphically depicts the frequency of farmers' WTP for GTs for marketing feeder cattle and retaining heifers. The most frequently cited WTP was $11-$20/head.

At the time of this writing in 2023, GTs cost $15/head, which means the average WTP exceeded the cost of commercially available GTs. More specifically, 87 percent of survey respondents interested in using GTs stated they would pay $15/head or more to test feeder cattle, and 90 percent stated they would pay $15/head or more for replacement heifer decisions. It is important to note that survey respondents were informed that GTs were priced between $17 and $37 per head at the time the survey was administered.

Among those interested in GTs, the percentage of cattle that producers would test was widely distributed. Most producers would test all potential replacement heifers and either half or all their calves to be marketed as feeder cattle (Figure 2). Producers only testing half of the feeder cattle to be marketed may consider this to be the minimum quantity to be representative of the herd. Averaging across all producers completing the survey, they stated they would test 55 percent of their cattle to be marketed as feeder cattle and 77 percent of their replacement heifers (Table 1). Thus, there is a greater interest in using GTs for making replacement heifer decisions given the higher WTP and greater percentage of replacement heifers they would test compared to feeder cattle for marketing. This result seems feasible in that utilizing genetic information to select replacement heifers will have a more direct and longer-term impact on an operation when compared to using such information to market feeder cattle to feedlots who may or may not pay more for the animals with the given information. No known research has evaluated if GTs actually increase prices paid. However, testing feeder cattle to decide which cattle to retain ownership of in the feedlot may also be beneficial if retained ownership is part of a producer's marketing plan, but this question was not fully evaluated in this study. An additional application of information from GTs is that it could be used to inform breeding programs including whole herd breeding or tailored mating decisions. Adoption of GTs is expected to increase as producers gain a better understanding of how GTs can be used to their advantage.

Table 2 provides a comparison of survey respondents who stated interest in using the GTs to market (Mkt) and retain heifers (Retain) versus non-interested respondents. Producers interested in GTs for marketing feeder cattle and retaining heifers are (1) more likely to have a college degree or higher, (2) younger, (3) more likely to have higher household income and more cattle, (4) more likely to have received information from UT Extension and breed associations and (5) and have greater risk preferences for new technology and financial matters related to their beef cattle business than those who were not interested (Table 2).

Table 3 contains the marginal effects of producers' interest in using GTs (Adopt), producer WTP for the GTs (WTP) and the percentage of animals the producers would test (%Tested) to both Mkt and Retain. As it relates to the likelihood to Adopt GTs, producers who used information from UT Extension for making beef cattle business decisions were 15 percent more likely to be interested in using GTs to market feeder cattle and 12.2 percent more interested in using the tests to retain heifers. This illustrates how lack of information may be a barrier to producer adoption of GTs. Additionally, producers with greater household income were more likely to adopt GTs to market feeder cattle.

Despite younger producers being more likely to use GTs, older producers had a higher WTP for GTs for marketing feeder cattle. This may indicate older producers had more money to spend on the technology. Another interesting finding was that education had little to no effect on adoption, WTP or percentage of cattle to test, but producers using information from UT Extension and breed associations were more likely to adopt GTs, pay more for the tests and test a higher percentage of cattle. This suggests that UT Extension and breed associations are conveying information concerning GTs' potential benefits.

Cattle producers with Angus cattle, a higher household income and a higher percentage of income from farming were positively associated with adopting GTs. However, farm size and operation type were not associated with adoption, WTP or the percentage of animals that producers would test. Producers interested in using GTs to obtain genetic information or information to market feeder cattle were willing to pay more for the tests and test more animals. Alternatively, producers who were interested in using GTs to make decisions regarding retained ownership in the feedlot did not display a change in WTP or the percentage of cattle they would test. Thus, producers placed a higher value on using the tests for determining genetic information and how to market feeder cattle compared to deciding whether to retain ownership in the feedlot. This is consistent with the summary statistics showing 54 percent of producers would use the tests to make retained ownership decisions, while 62 percent would use the information to receive genetic information, and 74 percent would use the information to market cattle.

Considering WTP, producers with Angus cattle were willing to pay $2.24 and $2.31/head more for GTs to market feeder cattle and retain replacement heifers, respectively, than those without Angus cattle. Producers utilizing breed associations information were willing to pay $1.96 and $3.92/head more for the tests to help market their cattle and retain heifers, respectively. Producers with fewer cattle and more willingness to take risk with respect to the beef business would pay more for GTs to market feeder cattle. Additionally, producers interested in GTs to receive genetic information or market their animals were willing to pay $1.61 and $2.07/head more, respectively, for GTs to market their feeder cattle. Similarly, producers using GTs to determine replacement heifers were willing to pay more for the GTs if they had a greater percentage of farm income, received information from UT Extension or were willing to take more risks regarding new technologies.

Producers willing to take more risks with respect to adopting new technology were more likely to adopt GTs and test more cattle for both marketing animals and determining replacement heifers. Producers less willing to take risks may be more uncertain about adopting the technology to make decisions because they are uncertain if adopting the technology would result in greater profits.

As it relates to the percentage of animals that producers would test, younger producers, producers receiving information from UT Extension and breed associations and those willing to take more risks regarding new technologies were more likely to test a larger percentage of animals. Similarly, for producers using the test to market feeder cattle, those with greater household income and those using the tests for genetics information or to help market cattle were more likely to test a greater percentage of animals.

CONCLUSION

GTs are available to cattle producers to determine an animal's potential in the feedlot or as replacement heifers. The goal of this publication was to report the findings of research that was conducted to determine if cattle producers would be interested in GTs to help market feeder cattle and/or select replacement heifers. Based on a survey of Tennessee cattle producers, 56 percent of respondents had an interest in using GTs to market feeder cattle, while 74 percent were interested in using GTs to determine replacement heifers. Producers interested in using GTs stated an average WTP of $21 and $23/head for GTs to market feeder cattle and to determine replacement heifers, respectively.

This research is beneficial to those creating and selling GTs. It demonstrates cattle producers have a stated interest in purchasing GTs and their WTP for the tests is greater than current market prices for many of the available tests. Results provide insight into the factors associated with Tennessee producers' adoption decisions regarding GTs for marketing feeder cattle and determining replacement heifers. It is clear that education by UT Extension and breed associations is a valuable tool to convey this information and increase awareness and adoption.

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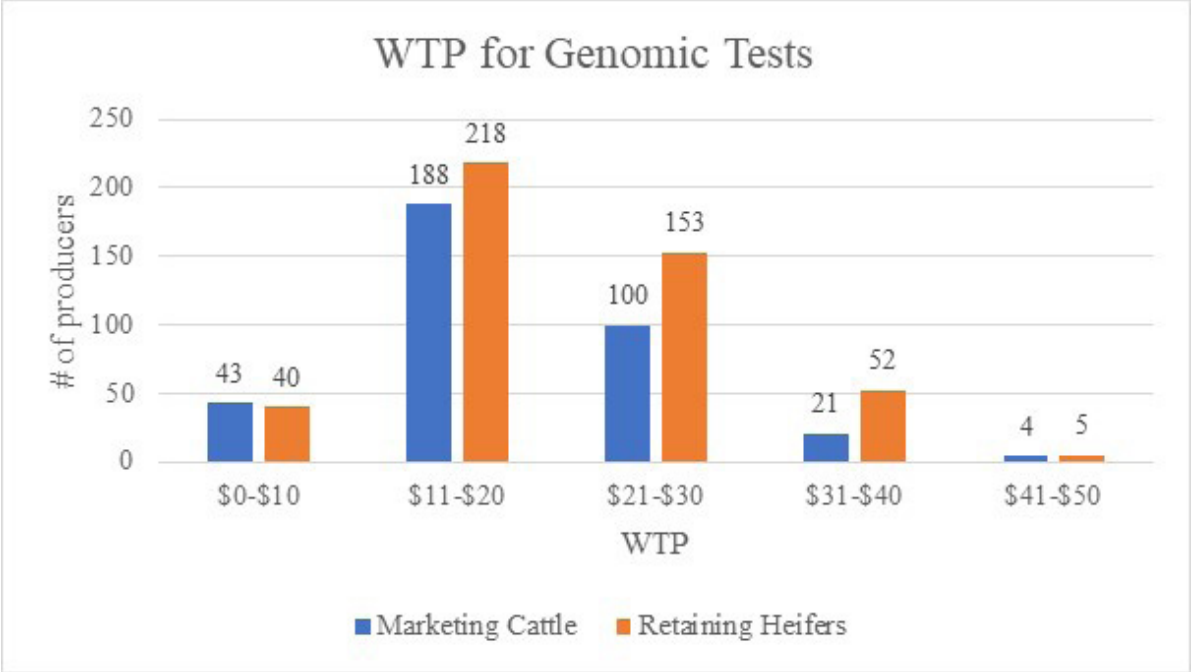

FIgure 1. *Stated WTP for genomic testing of marketing cattle and retaining heifers*
Source: K. L. DeLong, K. L. Jensen, C. N. Boyer, A.P. Griffith, and C. Martinez. Feeder cattle genomic tests.

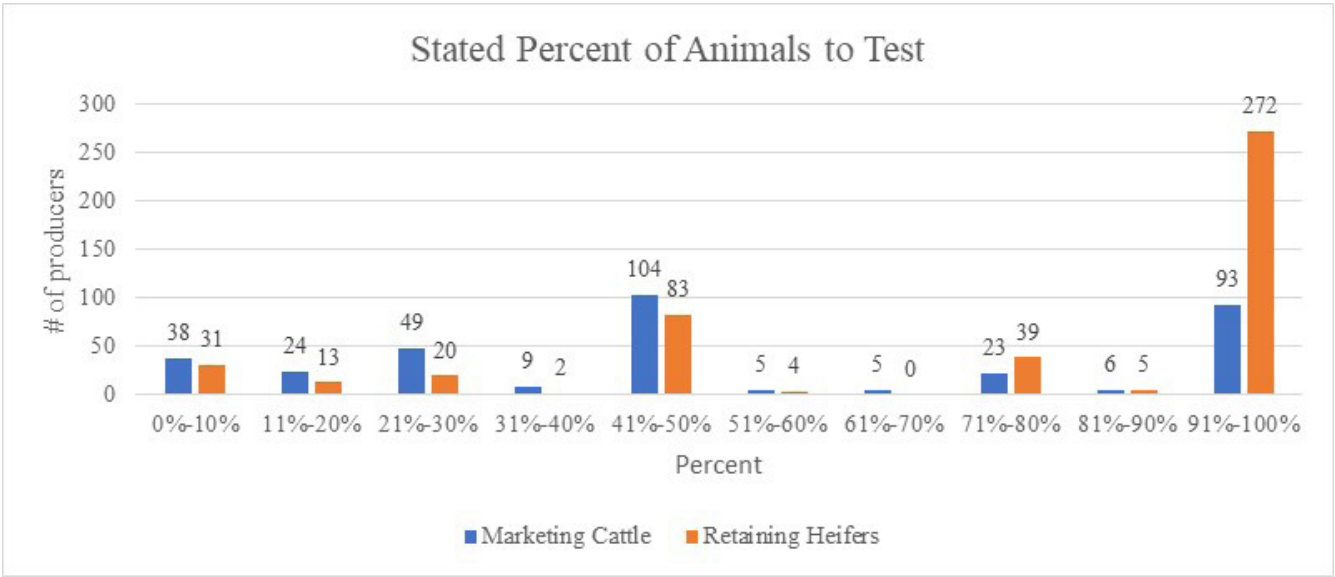

FIgure 2. *Stated percent of animals that cattle producers would get tested*
Source: K. L. DeLong, K. L. Jensen, C. N. Boyer, A.P. Griffith, and C. Martinez. Feeder cattle genomic tests.

Table 1. Summary statistics of dependent variables regarding decision to adopt genetic tests

VARIABLE	DESCRIPTION	MEAN	STANDARD DEVIATION	N
$Adopt^{Markect}$	1 if interested in using a genomic test to market steers and heifers	56.33%	0.50	632
$Adopt^{Retain}$	1 if interested in using a genomic test to determine replacement heifers	74.21%	0.44	632
WTP^{Market}	WTP for genomic test used to market animals	$20.77	7.93	356
WTP^{Retain}	WTP for genomic test to determine replacement heifers	$22.83	8.84	469
$\%Test^{Market}$	Percent of animals to test for marketing, if respondent stated interest in genomic testing	55.00%	32.77	356
$\%Test^{Retain}$	Percent of replacement heifers to test, if respondent stated interest in genomic testing	76.83%	31.54	469

Source: K. L. DeLong, K. L. Jensen, C. N. Boyer, A.P. Griffith, and C. Martinez. Feeder cattle genomic tests.

Table 2. Summary statistics of independent variables regarding decision to adopt genetic tests

		$Adopt^{Market}$		$Adopt^{Retain}$	
Dependent Variable	**Description**	**Yes**	**No**	**Yes**	**No**
Demographics					
College Graduate	College degree or higher	59.00%[a]	50.36%[a]	57.57%[a]	48.47%[a]
Household Income	2019 taxable household income (in $1000)	$133[a]	$116[a]	$128	$121
Farm Income	% income from farming	21.80%	20.51%	21.26%	21.17%
Age	Operator's age	54.47[a]	58.82[a]	55.28[a]	59.51[a]
Total Cattle	Total head of cattle	120.77[a]	98.32[a]	110.50	112.30
Angus	1 if have Angus cattle	79.78%	77.17%	79.32%	76.69%
Information Sources					
UT Extension	1 if obtains information from UT Extension	88.76%[a]	77.17%[a]	86.78%[a]	74.85%[a]
Breed Association	1 if one obtains information from breed associations	44.94%[a]	31.88%[a]	43.07%[a]	28.22%[a]
Operation Type					
Market Stockers	1 if markets stocker/backgrounder	52.81%	47.10%	49.89%	51.53%
Retain Ownership	1 if retains ownership	58.14%	59.42%	59.70%	55.83%
Risk Preferences[b]					
New Technology Risk	Adopting new farm technologies	7.05[a]	6.18[a]	6.88[a]	6.04[a]
Beef Business Risk	Financial matters related to the beef cattle	5.93[a]	5.46[a]	5.88[a]	5.26[a]
Test Uses					
Genetic Information	1=would use the test to receive info on genetics of animals	62.36%			
Market Aniimals	1=would use the test to receive info to market cattle	73.88%			
Retain Ownership	1=would use the test to determine whether to retain ownership of cattle	54.21%			
N		356	276	469	163

[a]As determined by a t-test, means are statistically different at the 5 percent level of significance.
[b] Participants were asked: "What is your willingness to take risks in the following activities with 1 indicating 'not at all willing to take risks' and 10 indicating 'very willing to take risks'."
Source: K. L. DeLong, K. L. Jensen, C. N. Boyer, A.P. Griffith, and C. Martinez. Feeder cattle genomic tests.

Table 3. Conditional mixed-process (CMP) of adoption decision for marketing steers and heifers: Probit and tobit marginal effects and regression coefficients[a,b]

	Adopt (probit marginal effects)		WTP (regression coefficients)		% Tested (double-bounded tobit marginal effects)	
Demographics	**Market**	**Retain**	**Market**	**Retain**	**Market**	**Retain**
College Graduate	0.040	0.023	-1.104	-1.327	3.358	3.008
Household Income	0.0004*	-1.6E-05	0.005	0.007	0.037**	0.023
% Farm Income	0.0006	-0.0002	0.027	0.045**	-0.063	-0.089
Age	-0.004***	-0.004***	0.096***	0.041	-0.191*	-0.286**
Total Cattle	0.0002	-6.5E-05	-0.006*	-0.005	0.001	-0.003
Angus	-0.007	0.039	2.244**	2.306**	3.257	3.110
Information Sources						
UT Extension	0.150***	0.122***	1.13	2.186*	14.324***	15.237***
Breed Association	0.108***	0.070**	1.957**	3.916***	9.431***	9.998***
Operation Type						
Market Stockers	0.019	0.007	0.132	-0.604	0.915	5.519
Retain Ownership	0.018	0.043	0.137	-0.240	-2.311	5.651
Risk Preferences						
New Technology Risk	0.040***	0.028***	-0.015	0.477*	3.588***	3.258***
Beef Business Risk	-0.008	-0.002	0.509**	0.342	-0.928	-0.008
	Adopt (probit marginal effects)		**WTP (regression coefficients)**		**% Tested (double-bounded tobit marginal effects)**	

[a] Log likelihood for steers=-2,955 and for heifers=-3,195. Standard errors are in parenthesis under their respective marginal effect or coefficient.
[b] The symbols denote statistically different from zero at α=0.01(***), α =0.05(**), and α =0.10(*).
Source: K. L. DeLong, K. L. Jensen, C. N. Boyer, A.P. Griffith, and C. Martinez. Feeder cattle genomic tests.

Table 3. Conditional mixed-process (CMP) of adoption decision for marketing steers and heifers: Probit and tobit marginal effects and regression coefficients[a,b] (CONTINUED)

	Market	Retain	Market	Retain	Market	Retain
Test Uses						
Genetic Information			1.607*		3.815*	
Market Animals			2.074**		6.385***	
Retain Ownership			0.315		2.738	
Constant			6.339**	8.870***		
N	632	632	356	469	356	469

[a] Log likelihood for steers=-2,955 and for heifers=-3,195. Standard errors are in parenthesis under their respective marginal effect or coefficient.
[b] The symbols denote statistically different from zero at α=0.01(***), α =0.05(**), and α =0.10(*).
Source: K. L. DeLong, K. L. Jensen, C. N. Boyer, A.P. Griffith, and C. Martinez. Feeder cattle genomic tests.

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