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Unintended consequences of the quest for increased efficiency in beef cattle: When bigger isn't better☆

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ABSTRACT

Federal funding has long supported the goal of increased beef cattle efficiency. Today, the U.S. produces more beef from fewer cattle due to the ability to get more meat from each animal. Average cattle slaughter weight has increased more than 330 pounds over the past 40 years. While the benefits of this increase in efficiency are well documented, unintended adverse consequences have been less well understood. This article aims to identify and quantify one of these adverse effects. With larger cattle have come larger steaks. In response, many retailers have begun offering thinner cuts to combat high total package prices. But, do consumers prefer larger, thinner steaks or smaller, thicker steaks? Using data from a nationwide survey, this article estimates consumer willingness to pay for beef steak dimensions to draw insights into the consumer welfare changes that have resulted from increasing steak sizes. Results imply that most consumers prefer thicker to thinner cuts steaks and that smaller surface areas are preferred to larger ones. Our estimates suggest that increases in welfare due to larger carcasses, say from lower prices and more ground beef, must offset an $8.6 billion annual loss in consumer welfare resulting from changing steak size.

1. Introduction

The number of cattle slaughtered in the U.S. is near the lowest levels in decades. However, total beef production has actually increased since 1977 (Fig. 1). The U.S. produced slightly more beef in 2015 as in 1977 but did so with 13 million fewer cattle (USDA, NASS, 2016). This feat was accomplished through increased carcass sizes as well as improved reproduction rates and increased feed conversion. Much of this increase in efficiency is due to research and innovation to produce more meat per carcass. Federal funding has played a key role in supporting research in this area and has clearly been very successful in supporting the goal of increased productivity through a variety of methods (Huffman and Just, 1994; Roberts et al., 2009; Alston et al., 2015; Ball et al., 2016; Jin and Huffman, 2016). Better genetics, selective breeding, improved nutrition, growth promotion technologies, marketing methods (i.e. live vs. grid), and economic conditions have all played a role in cattle becoming more efficient (Capper, 2011; Lusk, 2013).

While it is difficult to disentangle which factors have most contributed to rising carcass weights, the culmination of these factors has led to adjustments in the production and flow of cattle throughout the supply chain. Average slaughter weight for cattle has increased by about 330 pounds (lbs.) (150 kg) over the past 40 years and approximately 100 lbs. (45 kg) in the past 10 years (USDA, NASS, 2016). Carcasses weighing between 600 lbs. to 900 lbs. (272–408 kg) will generally not receive a discount based on carcass weight (USDA, AMS, 2016). The average carcass weights have been trending toward the upper bound of this range. Steer carcass weights in October 2015 averaged 926 lbs. (420 kg) which is the all-time monthly high and is a 26 lb. (11.8 kg) increase over October 2014 (USDA, NASS, 2016). Many meat packers have decreased or adjusted penalties for larger carcasses (USDA, AMS, 2016; CAB, 2012). The average discount for a carcass between 900 lbs. (408 kg) and 1000 lbs. (454 kg) was $6.82 per cwt in 2001–2002 and decreased to $1.59 per cwt in 2014–2015 (USDA, AMS, 2016). Even branded beef programs such as Certified Angus Beef have increased their carcass weight thresholds to allow larger cattle to qualify (Suther, 2006).

Not surprisingly, the increase in cattle slaughter weight has had a direct effect on the size of many beef cuts. Although the form of some products (e.g., ground beef) are largely unaffected by changing carcass size, weight and cross sectional area of cuts from subprimals, such as

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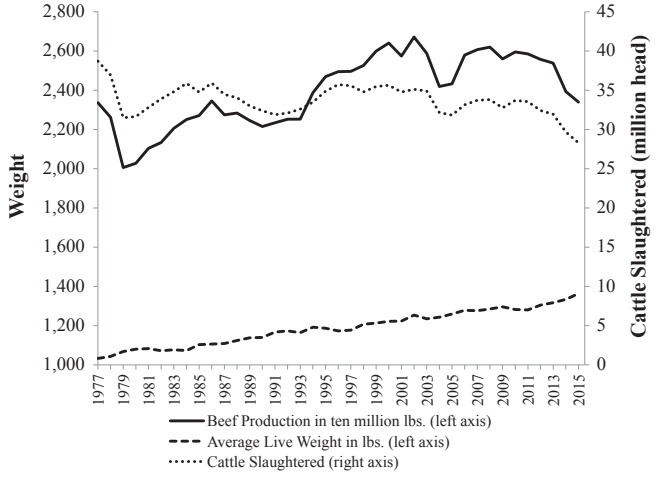

Fig. 1. Annual average cattle slaughter and average live cattle weight from 1977 to 2015 (USDA, NASS, 2016).

the longissimus muscle (LM), the muscle containing the ribeye, are highly correlated with the carcass size. The National Beef Quality Audits, which have been conducted about every five years since 1991, reported average carcass weight and average ribeye area for each year audited (Lorenzen et al., 1993; Boleman et al., 1998; McKenna et al., 2002; Garcia et al., 2008; Gray et al., 2012). Between the 1991 audit and the 2011 audit, average carcass weight increased from 761 lbs. to 825 lbs. (345–374 kg) and average ribeye area increased from 12.9 square inches (in^2) (83 cm^2) to 13.8 $in.^2$ (89 cm^2). Not surprisingly, across these five audits, the correlation between the mean carcass weight and the mean ribeye area is 0.97. Thus, as carcass size has increased over the years, so has the size of steaks from these muscles (Rutherford, 2013; NBQA, 2011).

Larger carcass sizes have brought about benefits for the consumer (larger supplies, leading to lower priced ground beef) and for the environment (fewer cattle needed to produce a given quantity of beef). However, larger steak sizes pose a concern for the beef industry as it becomes more difficult to fabricate consistent sized retail cuts and profitably meet the expectations of foodservice and retail consumers (e.g., Behrends et al., 2009; Leick et al., 2012; Peel, 2015). The most recent National Beef Quality Audit listed weight and size as one of the top six quality challenges (NBQA, 2011). As a response to varying muscle sizes such as the ribeye, grocery stores and restaurants are often forced to adjust the thickness to which the steaks are cut in order to meet a target retail weight. Thus, a ribeye steak from a carcass with a large LM will likely be cut thinner than a ribeye steak from a carcass with a smaller LM. This has led to the introduction of "thin cut" steaks in some grocery stores. Compounding the issue of altering larger steaks are the historically strong beef prices. Some retailers utilize target prices for packages of steaks. Therefore, consumers are not only facing high beef prices, but also an increase in total package price due to the larger dimensions of the steak. This has caused retailers to reduce thickness to meet a target package price.

The purpose of this research is to estimate consumers' preferences for steak size dimensions in order to gain insights into the welfare effects that have resulted from the increase in average carcass weight. Such size dimensions include steak cross sectional surface area (the length and width) and steak thickness; we consider the trade-off among these attributes and steak price for two types of steak.

Little research has examined the relationship and tradeoffs between steak surface area and steak thickness as it pertains to consumers' preferences. Leick et al. (2012) examined consumers' preferences for price, color, marbling, thickness, and visual texture by recruiting participants from college football picnickers. They found that consumers tended to select thinner ribeye steaks and thicker sirloin steaks, although results were not statistically significant at conventional levels. They concluded that marbling, color, and thickness were more important to consumers than price in their experiment.

Sweeter et al. (2005) analyzed South Dakota consumer preferences for the size of beef cuts. They divided 50 carcasses into 5 different LM size categories with similar backfat and marbling scores. The ribeye area range for cattle in the smallest category (average 659 lb. (299 kg) carcass weight) was 9.4 $in.^2$ to 10.5 $in.^2$ (60.6 cm^2 to 67.7 cm^2). For the largest category (average 853 lb. (387 kg) carcass weight) the ribeye area range was 16.3 $in.^2$ to 18.4 $in.^2$ (105.2 cm^2 to 118.7 cm^2). They found consumers were willing to pay $0.68 per pound more for the large (average 17.3 $in.^2$ (111.6 cm^2)) over average (average 13.2 $in.^2$ (85.2 cm^2)) sized steaks. Large steaks cut in half were also included and consumers discounted the "half-steaks" by $0.46 per pound compared to the average sized steaks.

A large number of other studies have analyzed consumer preferences for other beef attributes such as marbling, tenderness, labelling, food safety assurances, and animal feed using survey or experimental methods (e.g., Lusk et al., 2003, 2008; Killinger et al., 2004; Tonsor et al., 2009; Umberger et al., 2009; Tonsor et al., 2013). Other studies have analyzed meat attribute preferences using retail price or scanner data (e.g., Parcell and Schroeder, 2007; Taylor and Tonsor, 2013; Ward et al., 2008). Some of these later hedonic studies found that retail price per pound decreases as package weight increases. However, none of these previous studies have focused specifically on preferences for the area and thickness of steaks.

The next section describes our survey instrument, which was delivered to a national sample of N = 1027 consumers. We then discuss how our data are analyzed, and results are presented. The results allow us to draw conclusions about how the increase in the average carcass size impacts consumers' preferences for steaks.

2. Methods

We developed a survey to determine how differing levels of surface area, thickness, type of steak, and price influence consumers' choices among alternatives. The attributes and the levels used in the survey are shown in Table 1. The first section of the survey included questions about consumers' steak purchasing habits. Only respondents who identified that they eat steaks were included in the sample.

The second section of the survey administered the choice experiment questions in which respondents chose between two steaks with varying levels of the attributes. The attributes were displayed and varied graphically as a consumer would see them in the meat case at a grocery store. Each question included a choice between a ribeye steak, a

Table 1
Attributes and levels.

Attribute	Levels
Steak type	Ribeye Top sirloin
Thickness	0.5 in. (1.3 cm) 1.0 in. (2.5 cm) 1.5 in. (3.8 cm)
Ribeye steak area	10 $in.^2$ (64.5 cm^2) 14 $in.^2$ (90.3 cm^2) 18 $in.^2$ (116.1 cm^2)
Top sirloin steak area	20% decrease from average Average[a] 20% increase from average
Ribeye steak price	$5.00 per package $10.00 per package $15.00 per package
Top sirloin steak price	$2.00 per package $6.00 per package $10.00 per package

[a] The average top sirloin steak area was adjusted proportionally to the ribeye steak attribute levels.