

Consumer Surplus in the Digital Economy: Estimating the Value of Increased Product Variety

Erik Brynjolfsson^{*}, Michael D. Smith^{**}, and Yu (Jeffrey) Hu^{***}

This Version: August 2002

Acknowledgements: We thank Jerry Hausman, Lorin Hitt, and participants at the 2001 Workshop on Information Systems and Economics (WISE) for valuable comments on this research. We thank Al Greco, Vicki Jennings, Madeline Schnapp, and representatives of the American Booksellers Association, the American Wholesale Booksellers Association, the Book Industry Study Group, Barnes and Noble, Amazon.com, MIT Press and various other publishers and local booksellers for providing valuable information on the book industry. The Center for eBusiness at MIT provided generous financial support under a grant from Fleet Bank.

^{*} Sloan School of Management, Massachusetts Institute of Technology; email: erikb@mit.edu; web: <http://ebusiness.mit.edu/erik>

^{**} H. John Heinz III School of Public Policy and Management, Carnegie Mellon University; email: mds@cmu.edu; web: <http://www.heinz.cmu.edu/~mds>

^{***} Sloan School of Management, Massachusetts Institute of Technology; email: yuhu@mit.edu

Consumer Surplus in the Digital Economy: Estimating the Value of Increased Product Variety

ABSTRACT

We present a framework and empirical estimates that quantify the economic impact of increased product variety made available through electronic markets. Recent research has focused on the effect of increased competition on Internet market efficiency. While these efficiency gains significantly enhance consumer welfare, for instance by leading to lower average selling prices, our present research shows that increased product variety made available through electronic markets can be a significantly larger source of consumer welfare gains.

One reason for increased product variety on the Internet is the ability of online retailers to stock, display, and sell a large number of products. For example, the number of book titles available at Amazon.com is over 18 times larger than the number at a typical Barnes & Noble superstore, and 45 times greater than the number of books available at a typical large independent bookstore.

Our analysis indicates that the increased product variety of online bookstores enhanced consumer welfare by \$756 million to \$971 million dollars in the year 2000, which is at least five times as large as the consumer welfare gain from increased competition and lower prices in this market. There may also be large welfare gains in other SKU-intensive consumer goods such as music, movies, consumer electronics, and computer software and hardware.

1. Introduction

“Certainly new goods are at the heart of economic progress. But that realization is only the beginning of an understanding of the economics of new goods. The value created by new goods must somehow be converted into an exact quantitative measure...”

Timothy F. Bresnahan and Robert J. Gordon (1997, p. 1)

“The Internet is providing access for people who just can’t find the book they are looking for in a store.”

Nora Rawlinson, editor of Publishers Weekly, quoted in Investors Business Daily, June 2, 1999.

Information technology facilitates the delivery of many new products and services over electronic networks. As these electronic networks develop and mature, it will be important to quantify their value for customers, merchants, shareholders, and society. While much of the attention in academic research and in the press has been on the relative operational efficiency of the online channel versus traditional channels, we believe that important benefits lie in new products and services made available through these channels. While it has been relatively easy to quantify the operational costs of each channel, the value of new products and services made available through electronic networks has remained unquantified. By default, this value has been ignored, effectively treating convenience and selection as if its value were zero.

Our research focuses on increased product variety, one category of new products and services made available through electronic networks. Internet retailers have nearly unlimited “virtual inventory” through centralized warehouses and drop-shipping agreements with suppliers. Because of this, they can offer convenient access to a much larger selection of products than brick-and-mortar retailers can. To illustrate this, Table 1 shows the difference between the number of items available at Amazon.com and a typical large brick-and-mortar retailer for

several consumer product categories.¹ For example, as shown in the table, Amazon.com (and Barnesandnoble.com) provides access to over 1.8 million unique new book titles and millions more used book titles while conventional brick-and-mortar superstores carry between 40,000 and 100,000 unique titles. Thus, online consumers are able to locate, evaluate, order, and receive millions of books that are not available on the shelves of local bookstores. Large differences in product variety are also seen in music, movies, and consumer electronics products.

Table 1: Product Variety Comparison for Internet and Brick-and-Mortar Channels

<i>Product Category</i>	<i>Amazon.com</i>	<i>Typical Large Brick-and-Mortar Store</i>
Books	1,800,000	40,000 – 100,000
CDs	250,000	5,000 – 15,000
DVDs	18,000	500 – 1,500
Digital Cameras	213	36
Portable MP3 players	128	16
Flatbed Scanners	171	13

Furthermore, while some of these titles may be available from specialty stores or special ordered through brick-and-mortar stores, the search and transaction costs to locate specialty stores or place special orders are prohibitive for most consumers.² In effect, the emergence of online retailers places a specialty store at every shopper's desktop. This improves the welfare of all consumers by allowing them to buy specialty products they otherwise cannot buy or will not buy due to high transaction costs and low product visibility. This effect will be especially beneficial

¹ Inventory values for Amazon.com were obtained from industry estimates (books), wholesale suppliers to Amazon.com (CDs), and direct counting of normally stocked items. Inventory values for brick-and-mortar stores were obtained from interviews with managers and direct observation of inventory for Barnes and Noble Superstores (Books, CDs, DVDs), Best Buy (CDs, DVDs, Digital Cameras, Portable MP3 Players, Flatbed Scanners) and CompUSA (Digital Cameras, Portable MP3 Players, Flatbed Scanners).

² To illustrate this difference, on November 26, 2001 one of the authors ordered the same book through Barnesandnoble.com and through a special order at a local Barnes & Noble Superstore. The Barnesandnoble.com order process took 3 minutes to place, arrived in 3 days, and cost \$31.99. The Barnes and Noble order took nearly 1 hour to place (which includes driving time to and from the store to place the order, searching for the book in the store, searching for a sales person, placing and paying for the special order, and driving to and from the store to pick up the book when it arrived), took 8 days to arrive, and cost \$37.45.

to those consumers who live in remote areas where there are no specialty retailers in their neighborhood.

As one might expect, the lower transactions costs offered by the Internet have led to increased orders for many titles not previously stocked in brick-and-mortar stores. Frank Urbanowski, Director of MIT Press, attributed the 12% increase in sales of backlist titles directly to increased accessibility to these titles through the Internet.³ Similarly, Nora Rawlinson, the editor of Publishers Weekly, observes:

“Publishers are finding that books on their backlists are suddenly selling well. Bookstores are great for browsing but they are difficult places to find a specific title...The Internet is providing access for people who just can’t find the book they are looking for in a store.”⁴

The differences in variety reflect underlying differences in the technology and economics of conventional and Internet retailers. As noted by Saul Hansel in the New York Times:

“The average book may sit on the shelf of a store for six months or a year before it is bought. The cost of this inventory in a chain of hundreds of stores is huge. Amazon can keep just one or two copies in its warehouse — and still make the title available to the whole country — and restock as quickly as customers buy books.”⁵

Further, anecdotal evidence suggests that consumers place a high value on the convenience offered by Internet retailers when locating and purchasing obscure products. For example, ACNielsen’s 2001 Internet Confidence Index lists “wide selection of products” as one of the top three drivers of consumer ecommerce based on a survey of Internet purchasers. However, no systematic estimates exist to quantify the dollar value consumers place on the increased product variety available through Internet markets.

³ “University Presses Credit Internet For Increased Sales” Professional Publishing Report, January 29, 1999.

⁴ Quoted in Investors Business Daily, June 2, 1999.

⁵ Saul Hansel, “News Analysis: Amazon Looks for an Encore”, New York Times, January 26, 2002.

This paper represents a first effort to apply a methodology for estimating this value to one prominent category of products offered by Internet retailers — obscure book titles. Our methodology uses a small set of generally available statistics that track how consumers “vote with their dollars,” and thus may find application in a variety of product categories. The resulting estimates of consumer surplus will have important economic and public policy implications, especially as investors and managers try to understand and evaluate the value proposition of Internet-based commerce.

The remainder of the paper proceeds as follows. Section 2 presents the economic literature pertaining to consumer welfare gains from new goods and increased product variety. Section 3 develops a methodology to measure consumer welfare from increased product variety offered in Internet markets. Section 4 applies this methodology to obscure book sales over the Internet and section 5 concludes.

2. Literature Review

Current literature on valuing new goods and new product varieties follows two strands: One strand focuses on the theoretical modeling of a market in which firms sell differentiated products while the other strand is concerned with the empirical estimation of the welfare gain associated with the introduction of new goods or new varieties of goods.

Theoretical work on product differentiation can be traced to Hotelling (1929) and Chamberlin (1933). Hotelling introduces a spatial differentiation model in which heterogeneous consumers have uniformly distributed preferences over an interval. In this model, distance can be interpreted literally, as geography, or figuratively, for instance, as degrees of sweetness in a cola. Two firms are located at two extremes of the interval. Each consumer has unit demand and

incurs a transportation cost for each unit of length she has to travel. Hotelling's model shows that both firms sell products at prices above marginal costs and make positive profits.

Salop (1979) extends Hotelling's spatial differentiation model. Consumers are distributed uniformly on the circle. In the first period, potential entrants simultaneously choose whether to enter the market, and entrants are automatically located at equal distance from one another on the circle. Then in the second period, firms who enter set prices for their differentiated products so that to maximize their own profits. Salop obtains results in which firms charge prices above marginal cost but make zero profit because of the fixed cost of production and free entry threat. Salop's model has been extended in a variety of ways. For example, Bakos (1997) applies Salop's model in the context of consumer-product fit to show that lower search costs in electronic markets may lead to lower and more homogeneous prices.

Salop's model has been criticized because each firm only competes with its closest two neighbors, and this characteristic effectively sets all except two cross elasticities of demand to be zero. Because of this limitation, Salop (1979)'s model is called an oligopolistic competition model. In addition, neither Hotelling (1929) nor Salop (1979) allows a consumer to consume more than one variety of differentiated products. This assumption simplifies the analysis of their models, but it also limits the applicability of such model to today's economy.

In related research, Chamberlin (1933) and Lancaster (1987) discuss product differentiation both within and across firms. Chamberlin gives a definition of product differentiation: "A general class of product is differentiated if any significant basis exists for distinguishing the goods of one seller from those of another." Chamberlin (1933) is concerned with how one firm can differentiate its product from other firm's. Lancaster (1987) further notes that "a large firm may

differentiate its own product,” thereby becoming a “multi-product firm.” Both types of product differentiation processes will lead to increased product variety — the existence of multiple products within a product class — whether they are produced by the same firm or by different firms. In most markets we observe a mixture of these two.

More recently, Dixit and Stiglitz (1977) develop a monopolistic competition model in which there exists a single representative consumer who consumes a little bit of every available product instead of consuming only her most preferred product. The utility function of this representative consumer has two arguments, the quantity of a unit product and the “subutility” from consuming all other products. The subutility function has a constant-elasticity-of-substitution (CES) form. Dixit and Stiglitz derive the demand for products by solving the representative consumer’s utility-maximization problem, and then solving each firm’s resulting profit-maximization problem. They compare the free-market outcome of the number of product varieties to the number a social-welfare-maximizing social planner would choose, in order to reveal whether or not there exists excess variety/diversity.

Spence (1976) has also studied the effect of product differentiation on social welfare. He directly specifies a system of linear demand functions for N differentiated products and uses numerical examples to show that a monopolistic competition market doesn’t necessarily lead to results that maximize social welfare.

The development of an empirical methodology to estimate the welfare change has lagged far behind the development of theory of welfare. Classic economic theory shows that if the price of a good changes from p_0 to p_1 , a welfare measure is given by how much the consumer would pay, or would need to be paid, to be just as well off after the price change. This measure corresponds

to Hicks' (1942) compensating variation measure. Historically compensating variation has been difficult to measure because it involves the integration of unobservable Hicks' compensated demand curve. However, Hausman (1981) develops a closed form solution for measuring compensating variation under standard linear or log-linear demand functions. Other researchers have extended Hausman (1981)'s methodology to more general demand function by applying semiparametric and nonparametric econometric techniques (e.g., Hausman and Newey (1995)).

While these techniques can be readily used to measure changes in consumer welfare from price changes of existing goods, the question arises: how can one measure changes in consumer welfare from innovations that increase the product variety available in a market? Hausman (1997a) builds on Hicks's insights and proposes a solution to this problem by considering the newly available product's "virtual price" — the price that sets demand to zero. Thus, the welfare effect of the introduction of a new product is equivalent to the welfare effect of a price drop from the product's "virtual price" to its current price. Hausman (1997a) applies this technique to show that the FCC's decision to delay the introduction of voice messaging services reduces consumer welfare \$1.27 billion a year, and a similar delay in the introduction of cellular phone services reduces consumer welfare by more than \$25 billion a year.

Subsequent research has studied the welfare effects of other new goods in traditional markets, using similar or more refined models. Hausman (1997b) specifies a demand system for ready-to-eat cereals, which consists of three tiers: the brand-level demand, segment-level demand, and overall demand. He uses a data set collected at supermarket scanners and estimated that the consumer welfare gain from the introduction of Apple-Cinnamon Cheerios was \$70 million. Similarly, Nevo (2001) uses brand-level supermarket scanner data to estimate a discrete choice model of demand for ready-to-eat cereals. He extends the existing literature on demand

estimation by allowing coefficients in the discrete choice model to be individual-specific, and demonstrates how to obtain estimates of welfare changes in this specific setting of a discrete choice model of demand. He estimates that the aggressive introduction of new ready-to-eat cereal products leads to a widespread price increase across almost all brands in the time period between 1988 and 1992, which in turn causes significant consumer welfare losses.

Goolsbee and Petrin (2001) estimate a discrete choice model of demand for television delivery services (e.g., over-the-air, cable, satellite) using a data set on individual consumer's television choices. They find that the consumer welfare gain from the introduction of direct broadcast satellite television is between \$450 and \$500 million per year. Petrin (2001) estimates a discrete choice model of demand for automobiles. Instead of using consumer-level data, which are frequently hard to obtain, he estimates the demand system using market-level data augmented with data that relate consumer characteristics to characteristics of the products they purchase. His results show that the introduction of minivans by major automobile manufacturers causes a welfare gain of hundreds of millions of dollars per year during the time period from 1984 to 1988.

These empirical estimation papers require the identification of the demand curve, which can be difficult, and they use a partial equilibrium approach, which has been criticized by Bresnahan (1997). The partial equilibrium approach either assumes that prices of other existing goods manufactured by the same firm do not change or assumes that prices of other competing firms' goods do not change. If these assumptions do not hold, significant complications may occur and they may lead to overestimation or underestimation. Hausman and Leonard (2001) represent the latest improvement in the area of addressing those concerns. Instead of having only post-introduction data, as used in most papers that estimate the effect of the introduction of new

goods, they obtain both pre- and post-introduction data. Thus they are able to use both direct and indirect approaches to estimate the effect of new good introduction. By comparing results from these two approaches, they can assess the validity of the partial equilibrium assumptions. In addition, they separate the overall effect into two parts: the variety effect resulting from the availability of new goods and the price effect resulting from changes of prices of existing goods.

Several papers have looked at welfare gains from technological developments. Bresnahan (1986) measures the welfare gains in the financial services industry from the adoption of mainframe computers. Since mainframe computers are intermediate goods, he must first estimate a derived demand curve for intermediate goods and then integrate the area under the derived demand curve to get an appropriate estimate. He also shows this approach will generally underestimate welfare gains under imperfect competition.

Brynjolfsson (1995) estimates the consumer surplus from information technology investments by integrating the area under the demand curve for information technology. Using computing machinery price and purchase data from U.S. Bureau of Economic Analysis, he calculates four measures of consumer surplus: Marshallian surplus, Hicksian (exact) surplus, a nonparametric estimate, and an estimate based on index numbers. The four measures consistently indicate that information technology investments generate an increase of between \$50 and \$79 billion in consumer surplus in the base year of 1987. Brynjolfsson predicts that this number will grow significantly as IT investments grow over time.

Bils and Klenow (2001) argue that quantifying the aggregate value of new goods on a good-by-good basis is not feasible in many cases. Instead, they take an indirect approach to measure variety growth. They find that consumer spending has shifting away from “static” categories of

goods (i.e., those that have shown little variety gain), and that this shift has accelerated in the last twenty years. According to their econometric estimation results, such a shift implies that variety grows at about 1 percent per year over the period from 1959 to 1979, and grows at about 2 percent per year over the period from 1979 to 1999.

Similarly, Brooke (1991) explains the IT “productivity paradox” — declining rates of productivity growth in the U.S. during a time of large-scale investment in computer-based technology — by looking at variety growth in the U.S. economy. His analysis shows that slower productivity growth has been correlated with rising levels of product variety.

Putting this analysis into context, it is important to note that the introduction of new products and services into the economy has significant public policy implications. For example, the Stigler commission (NBER 1961) and the Boskin Commission (Boskin 1996, Boskin et al 1998) have concluded that the greatest flaw in the Consumer Price Index is its failure to account adequately for new goods and quality improvements in existing goods. Because the CPI has been slow to include these new and improved products, it overestimates the inflation in the economy by approximately 0.6 percent per year, and thus over-adjusts many cost of living indices (Boskin 1996).

It is also worth noting that there is a large body of marketing literature that studies the relationship between perceived variety and actual assortment in brick-and-mortar stores and how these factors affect consumer choice. Most researchers agree that consumers generally prefer more variety when given a choice, because more variety means that consumers are more likely to find a product that matches their tastes (e.g. Baumol and Ide 1956) and more variety improves flexibility which is important when consumers’ tastes/preferences are uncertain (e.g., Kahn and

Lehmann 1991). More recently, research shows that consumers' perception of variety is influenced not only by the number of distinct products, but also by things like the space occupied, arrangement, and repetition frequency. Thus, retailers are able to cut the number of SKUs without negatively affecting the perceived variety, if they do it properly (Dreze, Hoch and Purk (1994), Broniarczyk, Hoyer and McAlisster (1998)). In this paper, we focus on the impact that increased availability of products in the online channel has on consumers' actual purchase behavior. Thus, questions of shelf space and consumer perceptions are muted relative to the actual assortment of products and observed consumer behavior.

3. Methodology

This paper applies and extends existing welfare estimation techniques to measure the consumer welfare contribution from the increased product variety made available through electronic markets. To do this, we follow Hausman and Leonard (2001)'s derivation to break the total effect on consumer surplus of the introduction of a new product into two parts: the variety effect and price effect. The total effect on consumer surplus is the difference in the consumer's expenditure function before and after the introduction, measured at the level of post-introduction utility:

$$CV = e(p_{c0}, p^*, u_1) - e(p_{c1}, p, u_1) \quad (1)$$

where p_{c0} is the vector of pre-introduction prices of competing products, p^* is the virtual price of the new product (the price that sets demand to zero), p_{c1} is the vector of post-introduction prices of competing goods, p is the post-introduction price of the new products, and u_1 is the post-introduction utility level. In effect, equation (1) measures how much a pre-Internet consumer would need to be compensated in order to be just as well off as they would be after the

introduction of the Internet. Because of this, resulting consumer surplus calculations take into account any shifts in purchases between the two channels as a result of the introduction of the Internet.

Hausman and Leonard further show that the total effect can be written as the sum of two effects: the variety effect resulting from the availability of new products and the price effect resulting from changes of prices of existing products.

$$CV = [e(p_{cl}, p^*, u_1) - e(p_{cl}, p, u_1)] + [e(p_{c0}, p^*, u_1) - e(p_{cl}, p^*, u_1)] \quad (2)$$

When the vector of prices of competing goods does not change before and after the introduction of the new good, i.e., $p_{c0}=p_{cl}=p_c$, one only needs to measure the variety effect and we can redefine the expenditure function such that $e(p_c, \dots) \equiv e'(\dots)$:

$$CV = e(p_c, p^*, u_1) - e(p_c, p, u_1) = e'(p^*, u_1) - e'(p, u_1) \quad (3)$$

The assumption that $p_{c0}=p_{cl}=p_c$ appears to be valid in our empirical context because the overwhelming majority of book prices charged by brick-and-mortar stores have not changed as a result of the introduction of the Internet. Nearly all brick-and-mortar stores sold most titles at their manufacturer's suggested list price before the introduction of the Internet and continue to do so today.⁶

To apply equation (3) in practice, we specify a log-linear demand function, the most commonly used demand function in the consumer surplus literature (e.g., Brynjolfsson 1995, Hausman

⁶ Moreover, most studies have shown that Internet retailers tend to increase competition and place downward pricing pressure on brick-and-mortar retailers (e.g., Brynjolfsson and Smith (2000), Scott Morton, Zettelmeyer, and Silva-Risso (2001)). Thus, if brick-and-mortar prices were to change at all we would expect any response to be in the direction of lower prices following the introduction of the Internet, which would mean that we would underestimate true consumer surplus under the zero price change assumption.

1997a, Hausman 1997b, Hausman and Leonard 2001), for the new product made available by the Internet:

$$x(p, y) = Ap^\alpha y^\delta \quad (4)$$

In equation (4) p is the price of the new good, y is the income, α is the price elasticity, and δ is the income elasticity.

By Roy's identity we can write equation (4) as

$$x(p, y) = -\frac{\partial v(p, y) / \partial p}{\partial v(p, y) / \partial y}, \quad (5)$$

where $v(p, y)$ is the indirect utility function.

Solving this partial differential equation gives

$$v(p, y) = -A \frac{p^{1+\alpha}}{1+\alpha} + \frac{y^{1-\delta}}{1-\delta} \quad (6)$$

and the expenditure function

$$e(p, \bar{u}) = \left[(1-\delta) \left(\bar{u} + \frac{Ap^{1+\alpha}}{1+\alpha} \right) \right]^{1/(1-\delta)}. \quad (7)$$

Using equations (3) and (7), it can be shown (Hausman 1981) that the welfare impact of the introduction of a new good is given by

$$CV = \left[\frac{1-\delta}{1+\alpha} y^{-\delta} (p^* x_0 - p_1 x_1) + y^{(1-\delta)} \right]^{1/(1-\delta)} - y, \quad (8)$$

where CV is the compensating variation, δ is the income elasticity estimate, α is the price elasticity, y is income, (p_1, x_1) are the post-introduction price and quantity, and (p^*, x_0) are the pre-introduction virtual price and quantity.

Prior research has shown that income elasticity effects can be ignored for typical consumer goods where the purchase price is a small fraction of the consumer's annual income. For example, Hausman (1997a) finds that income elasticity has an insignificant effect on consumer surplus measurement for ready-to-eat-cereal and Brynjolfsson (1995) finds that estimates considering the income elasticity are nearly identical to those ignoring it in the context of computer purchases. Applying this assumption, equation (8) simplifies to

$$CV = -\frac{p_1 x_1 - p^* x_0}{1 + \alpha}. \quad (9)$$

This formula calculates the area under the demand curve and above the initial price, where the demand curve runs between the initial price (p_1) and the y-intercept. The y-intercept can be referred to as the “virtual price,” the price that sets demand equal to zero (Hausman 1997b).

Thus, for our purposes, to quantify changes in consumer surplus resulting from the introduction of a new good in typical consumer markets, one only needs the post-introduction price and quantity, pre-introduction price and quantity,⁷ and price elasticity of demand.

4. Data and Results

We use this methodology to measure the consumer surplus resulting from one particular category of new products offered in electronic markets — obscure books not readily available through brick-and-mortar retailers. As noted above, for many consumers, these obscure books can

⁷ Typically the pre-introduction quantity is zero, thus $p^* x_0 = 0$.

properly be categorized as “new” products because, while they are readily available in Internet markets, the transactions costs necessary to acquire these goods in physical markets are prohibitively high. The availability of these books to such consumers reflects the increased inventory carrying capacity of Internet retailers. Internet book retailers such as Amazon.com carry 18 to 45 times more titles than typical brick-and-mortar bookstores do. Furthermore, recommendation lists, customer and industry reviews, images of the book jacket and selected book pages, and convenient search facilities allow consumers to discover and evaluate obscure books in an online store that would have remained undiscovered in a conventional retail environment.

This product category also provides a useful starting point for surplus measurement because it represents a relatively mature Internet market, and because prior research has measured the reduction in prices from increased competition on the Internet (e.g., Brynjolfsson and Smith (2000)), providing a point of reference for our surplus measurements.

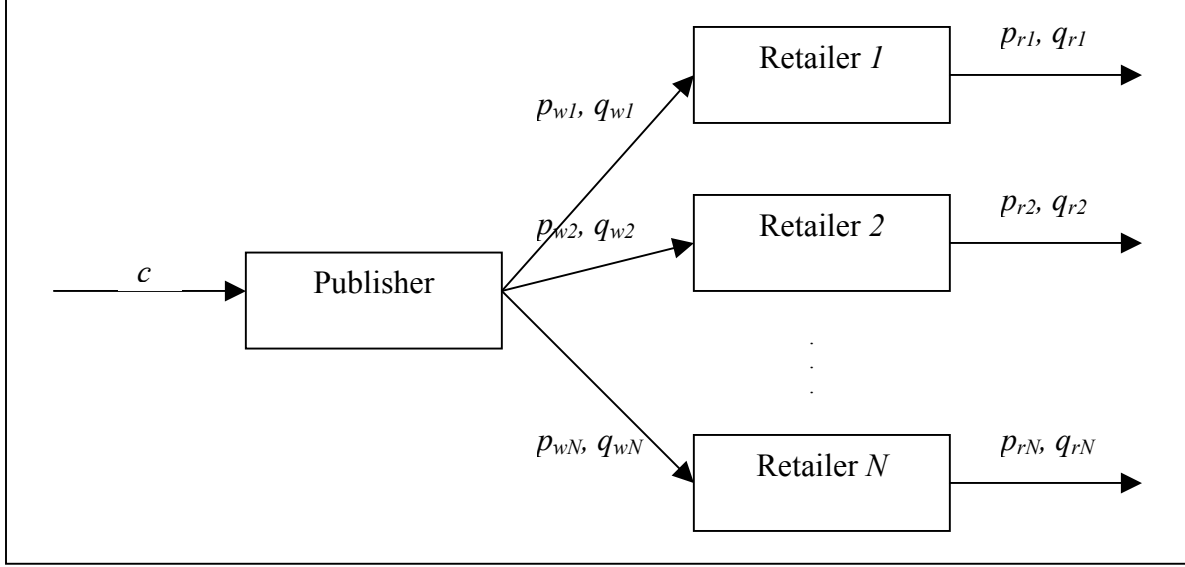
In the following sections, we discuss how we estimate the parameters necessary to calculate the consumer surplus resulting from increased accessibility to obscure book titles on the Internet: demand elasticity and the price and quantity of sales of obscure titles on the Internet.

4.1. Elasticity of Demand

In applying the methodology outlined above to the Internet book industry, we must take into account that the book industry is vertically structured as shown in Figure 1, where c is the

marginal cost of a book and p_{wi} , q_{wi} , p_{ri} , and q_{ri} are wholesale price and quantity and retail price and quantity for retailer i ($i=1,2,\dots,N$) respectively.⁸

Figure 1: Vertical Industry Structure in Book Sales



Publishers set both list prices and wholesale prices of the titles they publish. They sell books to retailers, either directly or through distributors, at prices that are a set percentage of the book's list price, typically between 43-51% of list prices. Thus, a change in the list price of a book would also result in a proportional change to the wholesale price of the book.⁹ Further, wholesale prices charged on an individual book are almost the same across retailers, regardless of the channel that the retailer operates in or the size of the retailer (Clay, Krishnan, Wolff (2001)).

Thus we have $p_{wi}=p_w$ for $i=1,2,\dots,N$.

⁸ This structure is accurate for the vast majority of consumer purchases, which are made through bookstores. However, in a few cases, customers choose to special-order books directly from the publisher. For our purposes, as long as these books are available from the publisher, at the same prices both before and after Internet book retailers introduce the increased selection of books, publisher special-orders will not affect our underlying model. This follows because, as noted above, the unchanged prices of competing goods are irrelevant to consumer surplus calculations from the introduction of new goods.

⁹ Source: conversation with Vicki Jennings, MIT Press, July 23, 2002.

Retailer i ($i=1,2,\dots,N$) receives books from either publishers or distributors, and then sell these books to consumers at some discount off the list prices.¹⁰ Therefore, for a given title, there exists a stable relationship between the book's wholesale price and retailer i 's retail price, $p_w=k_i p_{ri}$ where k_i is a constant between 0 and 1. In addition, according to several publishers we interviewed, as well as the American Wholesale Booksellers Association, the vast majority of books are sold on consignment. Typically, a retailer only pays for return shipping back to the publisher or distributor, but there are rarely any other penalties for returning unsold books to the publisher or distributor. Because of this the quantity sold from the publisher to retailer i equals the quantity sold from retailer i to the consumer in the long term, i.e., $q_{wi}=q_{ri}$. If we define $q_r = \sum_{i=1}^N q_{ri}$ as the total quantity sold by retailers to consumers and $q_w = \sum_{i=1}^N q_{wi}$ as the total net quantity sold by publishers to retailers, we easily get $q_r=q_w$.

Define retailer i 's market share on this title as $s_i = \frac{q_{ri}}{q_r}$. The weighted retail market price can

then be written as $\bar{p} = \sum_{i=1}^N s_i p_{ri} = \sum_{i=1}^N \frac{s_i}{k_i} p_w$. We find that

$$\frac{\overline{p} dq_r}{q_r d\overline{p}} = \frac{\overline{p} dq_w}{q_w d\overline{p}} = \frac{\left(\sum_{i=1}^N \frac{s_i}{k_i} p_w \right) dq_w}{q_w \left(\sum_{i=1}^N \frac{s_i}{k_i} dp_w \right)} = \frac{\left(\sum_{i=1}^N \frac{s_i}{k_i} \right) p_w dq_w}{q_w \left(\sum_{i=1}^N \frac{s_i}{k_i} \right) dp_w} = \frac{p_w dq_w}{q_w dp_w}, \quad (10)$$

¹⁰ This discount off list price is usually set by retailers in multiples of 10%. For example, in a representative sample of 23,744 titles sold at Amazon.com in late 1999, 88.5% of them follow such a pricing pattern — 29.5% have 0% discount, 1.4% have 10% discount, 34.3% have 20% discount, 18.4% have 30% discount, 1.6% have 40% discount, 3% have 50% discount, and 0.1% have 60, 70, 80, or 90% discounts. (See Smith 2001 for more information on this sample of titles.)

which means that the elasticity of aggregate demand in the retailing market equals the elasticity of demand that the publisher faces.¹¹

Since the publisher of a particular title has total control over establishing the title's list and wholesale price, it is reasonable to apply the well-known Lerner index formula to estimate the price elasticity of demand faced by the publisher.¹²

$$\frac{p_i - C_i'}{p_i} = -\frac{1}{\alpha_{ii}} \quad (11)$$

Discussions with various publishers indicate that gross margins on obscure titles are typically between 56-64%. For example, data from the American Association of Publishers suggests that gross margins are between 56-58% depending on whether shipping is included.¹³ MIT Press has gross margins of approximately 63%.¹⁴ A large publisher of technical books revealed they had gross margins of between 58-64% over the past several years. A large publisher of trade books revealed they had gross margins of approximately 60%.

Thus, using (11), the elasticity of demand faced by publishers is between -1.56 and -1.72. As explained in (10), the elasticity of aggregate demand in the retailing market equals the elasticity

¹¹ The elasticity of aggregate demand can be thought of as the percentage change in total market sales if all retailers changed their price by 1 percentage. In general, this will differ from the elasticity of demand faced by a particular retailer acting independently.

¹² This form of the Lerner index is applicable to single product monopolists, multiproduct monopolists who maximize profits on a per product basis, or in instances where cross elasticity is zero. In the more general multiproduct monopolist case, the Lerner index for product i is given by

$$\frac{p_i - C_i'}{p_i} = -\frac{1}{\alpha_{ii}} + \sum_{j \neq i} \frac{(p_i - C_i')q_j \alpha_{ij}}{p_i q_i \alpha_{ii}} \quad i = 1, \dots, n.$$
 However, in the Internet book market all available evidence suggests

that prices are set on an individual book basis and thus we use estimates based on equation (11) for our elasticity calculations.

¹³ Source: [http://www.nacs.org/common/research/textbook\\$.pdf](http://www.nacs.org/common/research/textbook$.pdf). Wholesale price includes publisher's income; publisher's paper, printing and editorial costs; author income; publisher's general and administrative costs; publisher's marketing costs; and freight expenses. Marginal cost includes publisher's paper printing and editorial costs, author income, and freight expense.

¹⁴ Source: conversation of Vicki Jennings, MIT Press.

of demand faced by the publisher, placing the elasticity of aggregate demand in the retailing market for obscure titles in this same range.

This estimate can also be compared with what other researchers have obtained, albeit using retailer data. For example, Brynjolfsson, Dick, and Smith (2002) use shopbot data to calculate an own price elasticity of -1.47 for retailers listing their prices at a popular shopbot, which is somewhat lower in absolute value than our estimates. Similarly, Goolsbee and Chevalier (2002) estimate a demand system for two online book retailers: Amazon and Barnes and Noble.com. The imputed demand elasticity using their calculations is also lower than our elasticity estimate. As noted in (9) a smaller elasticity will translate to larger consumer surplus. It is important to note that these elasticity estimates are for retailer elasticity not aggregate or publisher elasticity as required for our calculations. However, they provide a useful point of reference for our publisher elasticity calculations using the Lerner index.

4.2. Sales of Obscure Titles on the Internet

In order to estimate the consumer surplus from the introduction of convenient availability to obscure titles not normally offered in brick-and-mortar stores, it is necessary to calculate the sales of these titles through Internet outlets as compared to sales of these titles before the introduction of the Internet.

Internet retailers are extremely hesitant about releasing specific sales data and we were unable to obtain sales data from a major Internet retailer that would reflect the proportion of their sales in obscure titles. However, we were able to obtain data from one publisher that allows us to estimate the proportion of sales at Amazon.com by Amazon's sales rank of the product. Given

that Amazon.com holds a 70% share of the Internet book market (Ehrens and Markus (2000)), this should provide a reasonably accurate estimate of overall market sales.

This publisher provided data matching the publisher’s weekly sales for 321 titles to the sales rank observed at Amazon.com’s web site during the same week. These data were gathered for three weeks in the summer of 2001 and provide a fairly robust basis for correlating sales and sales rank position at Amazon.com. The observed weekly sales range from 1 to 481 units sold and the observed weekly sales rank ranges from the 238 to 961,367. Summary statistics for this data are shown in Table 2.¹⁵

Table 2: Summary Statistics for Amazon Sales-Rank Data

<i>Variable</i>	<i>Obs.</i>	<i>Mean</i>	<i>S.D.</i>	<i>Min</i>	<i>Max</i>
Weekly Sales	861	19.17	30.63	1	481
Weekly Sales Rank	861	31,532.85	58,350.92	238	961,367

To estimate a general curve to associate sales and rank, we use the Zipf curve, the standard specification for sales-rank data (e.g., Simon 1955, Reed 2001):

$$Quantity = \beta_1 \cdot Rank^{\beta_2} \quad (12)$$

Regressing log quantity onto log rank, we obtain an estimate of 37,274 for β_1 and -0.871 for β_2 as shown in Table 3 below.

¹⁵ The selection of titles was chosen by the publisher to encompass a range of sales profiles — from very popular to very unpopular. The profile of titles changed somewhat during the sample period to accommodate this and as a result not all titles were tracked in all weeks.

Table 3: Regression Results Amazon Sales-Rank Data¹⁶

<i>Variable</i>	<i>Coefficient</i>
Constant	10.526 (0.156)
Ln(Rank)	-0.871 (0.017)
R ²	0.8008

Both coefficients in this regression are highly significant and the R² value suggests that our model is precisely estimated. Furthermore, the estimates lead to plausible sales-rank results. For example, given our estimates, a book with a rank of 10 gets 5,000 sales per week and a book with a rank of 100,000 gets, on average, 1.6 sales per week. Likewise, integrating under the curve for titles with rank from 1 to 1.8 million suggests that Amazon.com was selling books at a rate of 81.1 million per year in the summer of 2001. This estimate compares well with industry statistics.¹⁷

These estimates also compare favorably with Zipf parameters obtained by Goolsbee and Chevalier (2002) using an easily executed experiment. To conduct this experiment, they first obtain information from a publisher on a book with relatively constant weekly sales (in their case 14 copies a week). They then purchase 6 copies of the book in a 10-minute period and track the Amazon rank before and shortly after the purchases.¹⁸ They estimate the Zipf parameters using two points: the daily sales and sales rank before and after the experiment. In their experiment

¹⁶ White robust standard errors are quoted based on the results of a Breusch-Pagan test confirming the presence of heteroskedasticity in the residuals. A graphical analysis suggests that the size of the residuals increases in rank. However, heteroskedasticity shouldn't affect our coefficient estimates, since OLS is consistent under heteroskedasticity. We also performed a test for structural change by interacting Ln(Rank) with a dummy variable that took on the value of one for ranks larger than 40,000. The coefficient on this variable was positive (but statistically insignificant) suggesting that our results would, if anything, be strengthened if we based our β_2 on only high rank books.

¹⁷ The 2001 Book Industry Trends lists 2000 total unit sales of books at 2.5 billion and their study also shows that the Internet makes up 6% of total book purchases. Amazon.com has a 70% share of the Internet book market (Ehrens and Markus 2000).

¹⁸ Note that Amazon updates sales ranks hourly for the 10,000 most popular books based on sales in the previous 24 hours (source: <http://www.amazon.com/exec/obidos/tg/browse/-/525376/104-2977251-9307125>).

they find β_2 as -0.855 (note that the θ reported by Goolsbee and Chevalier corresponds to $-1/\beta_2$). The authors also estimate β_2 from similar sales-rank data reported by Weingarten (2001) and Poynter (2000) as -0.952 and -0.834 respectively. While these parameter estimates rely on only 2 points they yield results that are remarkably similar to our results (which are based on 861 points).

We can use the Zipf parameter estimates from our data to calculate the proportion of unit sales at Amazon that fall above a certain rank as

$$r(x, N) = \frac{\int_1^N \beta_1 t^{\beta_2} dt}{\int_1^N \beta_1 t^{\beta_2} dt} = \frac{N^{(\beta_2+1)} - x^{(\beta_2+1)}}{N^{(\beta_2+1)} - 1}, \quad (13)$$

where x is the certain rank, and N is the total number of books available.

What rank cutoff is appropriate for our purposes? As noted above, we wish to estimate the gain in consumer surplus from access to books that are not normally stocked by the brick-and-mortar stores available to consumers. Thus, our rank figure should approximate the average number of books a consumer could easily locate in local physical stores.

At one end of the spectrum one would want to consider consumers who do not have easy access to bookstores with a broad selection of titles. In Appendix C of Brynjolfsson and Smith (2000), the authors calculate that the average consumer in the United States lives 5.4 miles away from the closest general selection bookstore. Using the same dataset, we find that 14% of U.S. consumers live more than 10 miles away from the nearest general selection bookstore and 8% live more than 20 miles from their nearest bookstore. For such customers the relevant rank might

be near 0. That is, without the Internet such customers would not be able to easily purchase general selection books.

More typically, consumers will have at least one and possibly multiple bookstores close-by. However, these Brick-and-Mortar bookstores vary significantly in their sizes: small bookshops and mall-based stores stock approximately 20,000 unique titles, large independent booksellers stock approximately 40,000 unique titles,¹⁹ large Barnes and Noble and Borders superstores stock approximately 100,000 unique titles, and the Barnes and Noble superstore in New York City, reported to be the “World’s Largest Bookstore,” carries 250,000 unique titles.²⁰

Table 4: Proportion of Sales from Obscure Titles at Amazon

<i>Sales Rank</i>	<i>Proportion in Total Sales</i>	<i>Standard Error</i> ²¹
>40,000	46.0%	2.3%
>100,000	36.9%	2.1%
>250,000	26.6%	1.7%

In Table 4 we estimate the proportion of total sales at Amazon.com that lie above a particular rank (i.e., titles that are not available at a typical brick-and-mortar bookstore) for each of the reference points discussed above. These calculations are based on equation (13) along with the estimates from Table 3 for β_2 and 1,800,000 (the number of books in print) for N . This table shows that 46.0% of Amazon’s unit sales fall in titles with ranks above 40,000 and 36.9% of sales fall in titles with ranks above 100,000, as Figure 2 illustrates. It is unlikely that every consumer will live within reasonable driving distance to the largest Barnes and Noble superstore

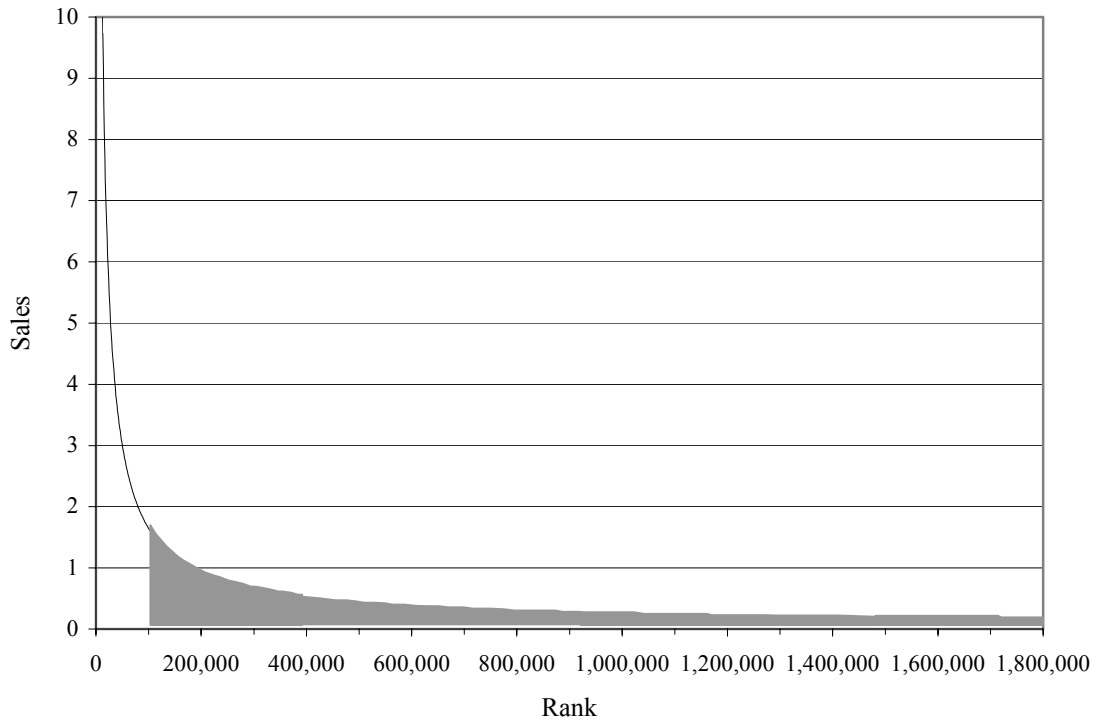
¹⁹ Harry Ritchie, “Fully Booked” Mail on Sunday, February 28, 1999 and various other industry sources.

²⁰ Correspondence with Mary Ellen Keating, Senior Vice President of Corporate Communications and Public Affairs, Barnes and Noble, December 3, 2001.

²¹ Since the proportion of Amazon unit sales that fall in titles with ranks lower than x ($x=40,000$, or $100,000$, or $250,000$) is a function of β_2 and we know the standard error of β_2 from the regression, we calculate the standard error of such an estimate using the Delta Method (see Greene 2000, p.118).

in New York City and have access to the 250,000 titles stocked there, but using that number as the cutoff point only reduces the proportion down to 26.6%.

Figure 2: Share of Amazon Sales Above Rank 100,000



In subsequent calculations we use a rank of 100,000 as our point-of-reference for consumer surplus estimates. This cutoff can be interpreted either in terms of the average stock levels at a Barnes and Noble or Borders superstore or as taking into account the possibility that consumers shop at multiple smaller independent stores.²² This large cutoff point seems conservative on two dimensions. First, it is unlikely that most consumers, particularly rural consumers as mentioned above, have access to this number of unique titles through local bookstores. Second, even if all consumers had access to these larger stores, the 100,000 cutoff will underestimate true consumer

²² For example, if there were only 50% overlap in stocked titles at large independent bookstores, a consumer would have to shop at a minimum of four such stores to have access to 100,000 titles.

surplus if, as seems likely, superstores do not stock exactly the 100,000 bestsellers at Amazon.com.

4.3. *Consumer Welfare*

According to 2001 Book Industry Trend, Book revenue in year 2000 was \$24.59 billion (Book Industry Study Group, 2001). Given that the Internet makes up 6% of total book sales (Book Industry Study Group, 2001), we estimate total Internet book sales in year 2000 to be \$1.475 billion. If we assume that obscure titles account for about the same proportion of total sales at other Internet book retailers as at Amazon, the sales of titles that are not available at a typical brick-and-mortar bookstore are \$544 million based on the estimates in Section 4.2.

Since these estimates are based on aggregate figures, it is further necessary to ensure that the average prices of obscure books sold on the Internet are not lower than the average prices of more popular books sold on the Internet. If average prices of obscure books were lower than more popular books, then we would overestimate the true consumer surplus by using aggregate figures. To analyze the relative prices of obscure and more popular books we selected 100 books at random from a sample of all customer searches at Dealtime.com on July 2, 2001. These data were obtained directly from Dealtime.com, a prominent shopbot for books. We then categorized the books into obscure and regular titles based on whether their Amazon.com sales rank was greater than (obscure) or less than (regular) 100,000.²³ Table 5 illustrates the difference between the prices of obscure titles and regular titles on the Internet within this sample and suggests that the prices of obscure books are greater than the prices of regular titles. Thus, if anything, our

²³ Analogous results are obtained using a cutoff of 40,000, the number of books stocked at a typical large independent bookseller.

estimates using aggregate sales figures will underestimate true consumer surplus from sales of obscure titles on the Internet.

Table 5: Price Comparison for Obscure Titles and Regular Titles on the Internet

<i>Amazon Sales Rank</i>	<i><100,000</i>	<i>>100,000</i>
Average List Price	\$34.53	\$42.18
Average Amazon Price	\$29.26	\$41.60
Average Price at Dealttime	\$29.52	\$39.06
Average Minimum Price at Dealttime	\$20.03	\$29.52
Observations	63	37

With these estimates of elasticity and revenue from obscure book sales, we use equation (9) to calculate that the introduction of previously unavailable book titles in online markets has increased consumer welfare by between \$756 million and \$971 million in the year 2000 alone, with standard errors of \$43.1 million and \$55.3 million respectively.^{24,25}

We also calculate the consumer surplus gains from increased competition and operational efficiency in Internet markets as a point of reference to the consumer surplus gains estimated above. Brynjolfsson and Smith (2000) calculated that prices on the Internet were 6-16% lower than prices in brick-and-mortar retailers due to increased competition and increased operational efficiency. A fractional price change of ϕ will lead to a $\phi^*\alpha$ change in quantity, according to the definition of elasticity of demand. Thus we have

$$CV = -\frac{p_1x_1 - p_0x_0}{1 + \alpha} = -\frac{(1 - \phi)p_0(1 - \phi^*\alpha)x_0 - p_0x_0}{1 + \alpha}, \quad (14)$$

²⁴ As above, these standard errors are calculated using the Delta Method (see Greene 2000, p.118).

²⁵ Also note that using a cutoff of 250,000 would reduce our consumer surplus estimates to between \$545 and \$701 million in the year 2000, with standard errors of \$34.9 million and \$43.6 million respectively. Using a cutoff of 40,000 would increase our consumer surplus estimates to between \$943 and \$1.21 billion in the year 2000, with standard errors of \$47.2 million and \$60.6 million respectively.

where CV is the change in consumer surplus from increased operational efficiency, α is the price elasticity, (p_t, x_t) are the current price and quantity (i.e. after the price change), and (p_0, x_0) are the previous price and quantity (i.e. before the price change).

As above, using figures from Book Industry Trends 2000 (Book Industry Study Group, 2001), we estimate the book sales on the Internet to be \$1.475 billion in year 2000 (i.e., $p_0 x_0 = \$1.475$ billion) and unit sales on the Internet to be 125 million (i.e., $x_0 = 125$ million). The price elasticity of demand α is between -1.56 and -1.72 and, using Brynjolfsson and Smith (2000), ϕ is between 0.06 and 0.16 . Given these statistics, equation (15) estimates the consumer surplus gain from a 6-16% drop in price for all titles on the Internet to be between \$80 million and \$150 million. Thus, the consumer welfare gain from the introduction of previously unavailable titles in the online channel is between five to twelve times as large as the consumer welfare gains from increased competition and lower prices on the Internet using estimates from Brynjolfsson and Smith (2000).

4.4. Discussion

While the magnitude of the consumer welfare gain from increased variety is large both in absolute terms and relative to the savings from lower prices, our approach is imperfect and is likely to underestimate the total welfare benefits for a number of reasons.

First, it is important to note that the book market is just one of many markets affected. Online sales of other consumer product categories, like music CDs, movies, and electronic products, are likely to also show significant gains in consumer surplus. Furthermore, these gains will increase as more customers gain access to the Internet channel and as new technologies such as print-on-

demand, digital content delivery, mobility services, and broadband access further reduce consumer search and transactions costs.

Second, there is some evidence that Internet may have reduced the effective cost of special orders even in offline stores, including the consumer time and effort required to identify the relevant books. Some obscure titles were available in brick-and-mortar stores through customer initiated special orders, even before the rise of the Internet as a channel for books. However, according to several bookstore owners we spoke to, special orders for items not normally stocked account for less than 1% of sales through the physical channel. This low level of special orders should not be surprising given that the special order process in a conventional store is inconvenient and time-consuming, as discussed above.²⁶

In particular, it is interesting to note that the availability of obscure titles on the Internet has apparently led to somewhat increased sales through special orders at brick-and-mortar stores. Several brick-and-mortar retailers we spoke to said that the Internet has allowed *brick-and-mortar* customers to locate and evaluate books they wouldn't have been able to find otherwise. Mary Ellen Keating, Barnes and Noble Senior Vice President of Corporate Communication and Public Affairs put it as follows with regard to sales in Barnes and Noble's brick-and-mortar stores:

²⁶ It is important to note that the Internet may also decrease the cost of placing these special orders. On October 26, 2000 Barnes and Noble announced a plan to install Internet service counters in all its superstores. These service counters would allow in-store customers to place orders from Barnes and Noble's Internet site for home delivery. While not included in our calculations, the availability of this service will increase consumer surplus by providing Internet access in new and convenient locations and potentially to some customers who otherwise would not have access to the Internet.

“Sales from special orders are up, and customers are ordering a broader range of titles in a number of different categories. What some customers tend to do is their own research on the Web and then special order the book from our stores.”²⁷

If the cost of special orders is unaffected by the Internet, then our consumer surplus calculations can ignore changes in the quantity of special orders, while our estimates would be raised if the effective cost of special orders were reduced. Lacking precise data on the costs or quantities of special ordering sales of obscure titles at brick-and-mortar stores, this potential consumer welfare gain is left out in our calculation. However, given that the Internet has, apparently led to a net increase in special order sales through the physical channel, our calculations will likely underestimate the true consumer surplus from the availability of obscure titles on the Internet.

Last but not least, our calculations focus on consumer welfare gains. There may also be significant gains in producer welfare from the additional sales. Indeed, retailers like Amazon, book publishers, printers, and authors, all stand to benefit and earn a slice of the growing pie created by lower search and transactions costs. In contrast, consumer welfare gains from lower prices come largely at the expense of producers.

5. Conclusions

While lower prices due to increased market efficiency in Internet channels provide significant benefits to Internet shoppers, the increased online availability of previously hard-to-find products represents a much larger positive impact on consumer welfare in the market we analyze. Limited shelf-space in conventional retail outlets constrains the types of products that can be discovered, evaluated, and easily purchased by consumers. Limits on the number of titles Internet retailers can present and sell to consumers are substantially lower. As a result, Internet customers have

²⁷ Source: E-mail communication with Mary Ellen Keating, December 3, 2001.

access to millions of products that they could not easily locate or purchase through brick-and-mortar retailers.

To date, the economic effect of increased product variety on the Internet been ignored, effectively setting to zero the value consumers place on increased selection at Internet retailers. Recent econometric advances have allowed for the measurement of the economic impact of such new goods. Our research applies and extends these methodologies to quantify an important welfare impact of online markets. Preliminary calculations for one product category sold in U.S. markets show that the welfare gains are between \$756 million and \$971 million dollars for the year 2000 alone. These welfare gains are five to twelve times as large as the consumer welfare gain from increased competition and lower prices uncovered in previous research (Brynjolfsson and Smith 2000).

It is important to note that our calculations demonstrate that, while making more and more titles available online will result in higher sales, there is a diminishing return on adding titles.

According to our Zipf curve estimates, titles ranked from 100,000 to 200,000 account for 7.7% of sales at Amazon.com while titles ranked between 200,000 to 300,000 account for only 4.7% of sales.

There are a variety of ways our results can be extended by future research. First, while our results use the well-known Lerner index to obtain elasticity calculations, it may be possible for future research to directly estimate these elasticities using an experiment in cooperation with a publisher of obscure books or possibly a retailer with a dominant market position. Such an experiment would change wholesale prices on a randomly selected set of titles and track the resulting levels of demand. These price changes would be exogenous if both the titles and price

change levels (positive and negative) were selected at random for the purposes of this experiment. Another way to extend our results would be to apply these calculations to measure welfare contributions of other SKU-intensive consumer goods categories sold on the Internet or other new goods made available through Internet markets. Additionally, future research can use this methodology to track changes in consumer surplus resulting from increased access to Internet markets over time or from further decreases in search and transactions costs resulting from new digital production and delivery technologies.

References

- Bakos, J. Yannis. 1997. Reducing buyer search costs: Implications for electronic marketplaces. *Management Science* **43**(12) 1613-1630.
- Baumol, William, and Edward A. Ide. 1956. Variety in Retailing. *Management Science* **3**(1) 93-101.
- Bils, Mark, and Peter J. Klenow. 2001. The Acceleration in Variety Growth. *American Economic Review Papers and Proceedings*, **91**(2) 274-280.
- Boskin Commission Report. 1996. Toward a More Accurate Measure of the Cost of Living, Final Report to the Senate Finance Committee from the Advisory Commission to Study the Consumer Price Index. Available at <http://www.ssa.gov/history/reports/boskinrpt.html>.
- Boskin, Michael J., Dulberger, Ellen R., Gordon, Robert J., Griliches, Zvi, and Jorgenson, Dale W. 1998. Consumer Prices, the Consumer Price Index, and the Cost of Living. *Journal of Economic Perspectives* **12**(Winter) 3-26.
- Book Industry Study Group. 2001. *Book Industry Trends 2001*. R. R. Donnelley and Sons, Allentown, PA.
- Bresnahan, Timothy F. 1986. Measuring Spillovers from Technical Advance: Mainframe Computers in Financial Services. *American Economic Review* **76**(4) 742-755.
- Bresnahan, Timothy F. 1997. Comments on "Valuation of New Goods under Perfect and Imperfect Competition". Bresnahan and Gordon, eds. *The Economics of New Goods*. The University of Chicago Press, Chicago, IL, 237-247.
- Bresnahan, Timothy F., and Robert J. Gordon. 1997. *The Economics of New Goods*. The University of Chicago Press, Chicago, IL.
- Broniarczyk, Susan M., Wayne D. Hoyer, and Leigh McAlister. 1998. Consumers' Perceptions of the Assortment Offered in a Grocery Category: The Impact of Item Reduction. *Journal of Marketing Research* **35**(2) 166-176.
- Brooke, Geoffrey M. 1991. Information Technology and Productivity: An Economic Analysis of the Effect of Product Differentiation. Ph.D. Thesis, University of Minnesota, Minneapolis, MN.
- Brynjolfsson, Erik. 1995. The Contribution of Information Technology to Consumer Welfare. *Information Systems Research* **7**(3) 281-300.
- Brynjolfsson, Erik, and Michael Smith. 2000. Frictionless Commerce? A Comparison of Internet and Conventional Retailers. *Management Science* **46**(4) 563-585.
- Chamberlin, E. 1933. *The Theory of Monopolistic Competition*. Harvard University Press, Cambridge, MA. (8th edition, 1962).

- Clay, Karen, Ramayya Krishnan, and Eric Wolff. 2001. Price strategies on the web: Evidence from the online book industry. *Journal of Industrial Economics* **49**(4) 521-540.
- Dixit, Avinash K., and Joseph E. Stiglitz. 1977. Monopolistic Competition and Optimum Product Diversity. *American Economic Review* **67**(3) 297-308.
- Dreze, Xavier, Stephen J. Hoch, and Mary E. Purk. 1994. Shelf Management and Space Elasticity. *Journal of Retailing* **70**(4) 301-326.
- Ehrens, Scott, Adria Markus. 2000. Amazon.com: There's An "R" in E-Tailing. Epoch Partners Consumer Internet Company Report, November 13, Page 4.
- Goolsbee, Austan, and Amil Petrin. 2001. The Consumer Gains from Direct Broadcast Satellites and the Competition with Cable Television. NBER Working Paper No. W8317, Cambridge, MA.
- Goolsbee, Austan, and Judith Chevalier. 2002. Measuring Prices and Price Competition Online: Amazon and Barnes and Noble. Working Paper.
- Greene, William H. 2000. *Econometric Analysis*. Prentice-Hall, Upper Saddle River, NJ.
- Hausman, Jerry A. 1981. Exact Consumer's Surplus and Deadweight Loss. *American Economic Review* **71**(4) 662-676.
- Hausman, Jerry A. 1997a. Valuing the Effect of Regulation on New Services in Telecommunications. *Brookings Papers: Microeconomics*, 1-38.
- Hausman, Jerry A. 1997b. Valuation of New Goods under Perfect and Imperfect Competition. Bresnahan and Gordon, eds. *The Economics of New Goods*. The University of Chicago Press, Chicago, IL, 209-237.
- Hausman, Jerry A., and Greg Leonard. 2001. The Competitive Effects of a New Product Introduction: A Case Study. *Journal of Industrial Economics* Forthcoming.
- Hausman, Jerry A., and Whitney Newey. 1995. Nonparametric Estimation of Exact Consumer's Surplus and Deadweight Loss. *Econometrica* **63**(6) 1445-1476.
- Hicks, John R. 1942. Consumer's Surplus and Index Numbers. *Review of Economic Studies* **9**(2) 126-137.
- Hotelling, Harold. 1929. Stability in Competition. *Economic Journal* **39**(153) 41-57.
- Kahn, Barbara, and Donald R. Lehmann. 1991. Modeling Choice Among Assortments. *Journal of Retailing* **67**(3) 274-299.
- Lancaster, Kelvin. 1987. Product Differentiation. in Eatwell J. et al (eds.), *The New Palgrave: A Dictionary of Economics*. Stockton Press, New York, NY.

- National Bureau of Economic Research. 1961. The Price Statistics of the Federal Government: Review, Appraisal, and Recommendation. Price Statistics Review Committee, General Series, no. 73, New York, NBER.
- Nevo, Aviv. 2001. New Products, Quality Changes and Welfare Measures Computed From Estimated Demand Systems. NBER Working Paper No. W8425, Cambridge, MA.
- Petrin, Amil. 2001. Quantifying the Benefits of New Products: the Case of the Minivan. NBER Working Paper No. W8227, Cambridge, MA.
- Reed, William J. 2001. The Pareto, Zipf and other power laws. *Economics Letters* **74**(1) 15-19.
- Salop, Steven. 1979. Monopolistic Competition with Outside Goods. *Bell Journal of Economics* **10** 141-156.
- Scott Morton, Fiona M., Florian Zettelmeyer, Jorge Silva-Risso. 2001. Internet Car Retailing. *The Journal of Industrial Economics*, **49**(4) 501-520.
- Simon, Herbert A. 1955. On a Class of Skew Distribution Functions. *Biometrika* **42**(3) 425-440.
- Smith, Michael. 2001. The Law of One Price? Price Dispersion and Parallel Pricing in Internet Markets. Working Paper, Carnegie Mellon University, Pittsburgh, PA.
- Spence, Michael. 1976. Product Differentiation and Welfare. *American Economic Review* **66**(2) 407-414.
- Weingarten, Gene. 2001. Below the Beltway, Washington Post, June 17, 2001.
- Yahoo!/ACNielsen Internet Confidence Index. 2001. Available at <http://www.acnielsen.co.id>.