EMPIRICAL ANALYSIS OF INTERNET-ENABLED MARKET TRANSPARENCY: IMPACT ON DEMAND, PRICE ELASTICITY, AND FIRM STRATEGY

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I. INTRODUCTION

The Internet brought about significant changes in the availability of market information to consumers (Tapscott and Ticoll, 2003). It reduced information search costs, offering consumers multiple purchasing channels and product options. For example, air travelers are now able to browse the Web for hundreds of travel offers to their destination, compared to typically few offers from a preferred travel agent or airline prior to the Internet era. The Internet has increased the level of *market transparency*, the ability of buyers, sellers, and intermediaries to observe market information. Two forms of market transparency have been particularly affected, product and price transparency. *Product transparency* is related to information about available product variants and their characteristics. *Price transparency* is related to market price information.

IT-enabled market transparency is a strategic paradox for organizations. With well-informed consumers, a benefit of the Internet—making information available to facilitate product marketing and distribution—also makes it difficult to capture profits (Porter, 2000). Therefore, firms face the challenge of balancing the trade-off between the benefits of attracting consumers with market information, and the risk of losing information advantages. However, there is little research regarding the impact of market transparency on consumers' economic behavior.

Our research questions are: What is the impact of IT-enabled market transparency on consumer demand? What are the implications for firm strategy? We provide empirical evidence of the impact of market transparency on consumer demand and price sensitivity. We estimate air travel demand using a large data set of airline tickets sold by U.S. travel agencies during a one-year period, and develop measures of market transparency to test hypotheses on the impact of market information on consumer demand and price elasticity of demand. This is the first study that associates transparency levels in B2C electronic markets with historical sales and prices. Next, we show how IT has enabled B2C air travel markets with different transparency levels.

II. B2C ELECTRONIC MARKETS IN THE AIR TRAVEL INDUSTRY

Since the first Internet travel website was launched in 1995, there has been unprecedented growth in online airline ticket sales. A 2003 industry survey estimated that the percentage of tickets sold over the Internet had reached 16% worldwide and 40% in North America (O'Toole, 2003). The fast growth of Internet-based airline ticket sales was facilitated by existing *global distribution systems* (GDSs), which were developed by airlines in the 1980s to distribute airline tickets via travel agencies. With the Internet now though, online travel agencies (OTAs) use GDSs to power their airline ticket search and booking engines.

In 2001 major U.S. airlines launched Orbitz, claiming that it was the most transparent travel website in the market. Orbitz introduced new technologies to improve on existing itinerary display limitations of the GDSs, and developed special contracts with other airlines to obtain the lowest fares in the market. Meanwhile, other competitors have introduced niche strategies with innovative, non-transparent mechanisms, such as Priceline.com. We view OTAs as performing field experiments with different levels of market transparency, providing a setting to test how variance in information disclosure by sellers affects consumer behavior. Next, we provide

theory-based hypotheses to test the impact of IT-enabled market transparency on consumers.

III. PROPOSITIONS AND HYPOTHESES

Our review of the relevant theory suggests that the effect of market transparency may be positive or negative, depending on the type of information disclosed.

Price Transparency Impacts. Lower search costs for price information may lead to lower prices, to the benefit of consumers. Bakos (1997) modeled the informational effect of e-markets and concluded that lower search costs reduce the ability of sellers to extract monopolistic profits, as sellers lose their ability to exploit high search costs, or alternatively, due to an increased ability of consumers to find lower market prices. In the air travel industry, given the existing price dispersion reported by Clemons, et al. (2002) and others, the price transparency offered by OTAs may drive prices down, as consumers discover lower fares. This theoretical background can be summarized as:

- **Proposition 1 (The Price Transparency Proposition):** *Price transparency is negatively related to consumers' willingness-to-pay.*

Product Transparency Impacts. Reduced search costs for product information may improve market efficiency and prevent market failure (Bakos, 1997). Consider a perspective that is consistent with Akerlof (1970): a diminution in information asymmetry between buyers and sellers regarding product quality will help to shore up the fundamentals of a sound market. For example, Brynjofsson, et al. (2003) found an increase in consumer surplus due to increased product variety offered by online bookstores. Lynch and Ariely (2000) performed experiments of Internet-based online wine sales and found that transparency about product quality and store comparison ability increases consumer retention. This leads to our second proposition:

- **Proposition 2 (The Product Transparency Proposition):** *Product transparency is positively related to consumers' willingness-to-pay.*

Market Transparency and Consumers' Sensitivity to Price Changes. Through a meta-analysis of previous studies, Kaul and Wittinck (1995) found that price advertising leads to higher price sensitivity among consumers, and that product advertising leads to lower price sensitivity on the part of consumers. Advertising is associated with higher levels of transparency, which leads to the following propositions:

- **Proposition 3 (The Price Transparency – Price Sensitivity Proposition):** *Price transparency increases consumers' sensitivity to prices.*
- **Proposition 4 (The Product Transparency – Price Sensitivity Proposition):** *Product transparency decreases consumers' sensitivity to prices.*

Hypotheses. Consumers' willingness-to-pay in air travel is difficult to measure, but impacts of market transparency on consumer behavior can be measured in terms of consumer demand and price elasticity of demand (Granados et al., 2005). We test four related hypotheses:

- **H1**: *Price transparency is negatively related to air travel demand.*
- **H2**: *Product transparency is positively related to air travel demand.*
- **H3**: *Price transparency is positively related to price elasticity of air travel demand.*
- **H4**: *Product transparency is negatively related to price elasticity of air travel demand.*

IV. DATA

To test our hypotheses regarding the impact of market transparency on consumer demand and price elasticity, we analyzed a cross-sectional data set of economy class tickets sold by U.S. OTAs and traditional travel agencies for 46 city pairs during September 2003 to August 2004. It has 4,200 records with information for 1.32 million outbound tickets, aggregated by *agency type*,

time of purchase, and *season*. Excluded are airline direct sales, including frequent flyer award tickets, which are transacted through airline portals or reservation offices. Agency types are *Expedia*, *Travelocity*, *Orbitz*, *Hotwire*, *Online Other*, and *Offline*. Agencies that did not sell tickets online were classified as *Offline*.

V. METHODOLOGY AND RESULTS.

We consider a model of the form $x = f(p, \boldsymbol{\tau}, \mathbf{c})$, where x is air travel demand, p is average market price, $\boldsymbol{\tau}$ is a vector of transparency variables, and $\mathbf{c}$ is a vector of control variables. Our operational definitions of *product transparency* and *price transparency* are the availability and accessibility of product and price information, respectively. We use measures of transparency as in Lynch and Ariely (2000), but break them into two categories to obtain a *composite measure*:

1) *Availability*: Upfront display of flight search results in the first screen.

2) *Accessibility*: Sorting and comparison functionality of the flight search results.

Market Transparency and Consumer Demand. To test hypotheses *H1* and *H2*, which suggest that product and price transparency have an opposite effect on consumer demand, we consider an industry-level air travel demand model, which commonly uses linear or log-linear specifications. Consistent with prior studies of Internet-based demand (Brynjolfsson, et al., 2003), we use log-linear demand, which can be estimated using OLS regression:

$$QUANTITY = CONSTANT * PRICE^{\eta} * PRICETRANS^{\beta_1} * PRODTRANS^{\beta_2} * INCOMEOD^{\beta_3} * ADVPURCH^{\beta_4} * \prod_j \alpha_j D_j * \varepsilon,$$

where $-\eta$ is price elasticity of demand, β_i's are coefficients to be estimated, D_j's are origin city dummies, and ε is an error term. See the variable definitions and results in Table 1.

Table 1. Air Travel Demand Model Variables and Regression Results

VAR. TYPES	VARIABLE	DEFINITION	COEFF	ROBUST STD. ERROR
Dependent	*QUANTITY*	Tickets sold		
Independent	*PRICE*	Average price paid	-0.58***	0.05
	PRICETRANS	Availability and accessibility of market prices	-1.08***	0.02
	PRODTRANS	Availability and accessibility of product characteristics and quality	2.68***	0.32
Control	*INCOMEOD*	Sum of gross product per capita of origin and destination cities.	3.26***	0.25
	ADVPURCH	Time of purchase in weeks before flight departure	-1.48***	0.03
	CONSTANT	Regression intercept	0.35***	0.10

Note: Model: N = 4,200. Log-linear regression with robust standard errors. R^2 =71%. Significance levels for coefficients: * p<0.10, ** p<0.05, *** p<0.01. We performed diagnostics for non-linearity, multicollinearity, heteroskedasticity and endogeneity. Based on existing heteroskedasticity, we used a log-linear regression with Huber-White sandwich estimators.

H1 and *H2* can be written in terms of β_1 and β_2, the coefficients of *PRICETRANS* and *PRODTRANS*, as: *H1*: $\beta_1 < 0$, and *H2*: $\beta_2 > 0$. The coefficient of *PRICETRANS* was negative and significant (-1.08, std. err.=0.02, p<0.01). But the coefficient of *PRODTRANS* was positive and significant (2.68, std.err.=0.32, p<0.01). We conclude that price transparency has a negative relationship with air travel demand while product transparency exhibits a positive relationship.

Market Transparency and Price Elasticity. To test the hypotheses for the relationship between market transparency and price elasticity, we compared price elasticities of travel agencies that have different measures of market transparency. We consider the model

$$QUANTITY = CONSTANT * PRICE^{\eta+\gamma A} * INCOMEOD^{\beta_3} * ADVPURCH^{\beta_4} * \prod_j \alpha_j D_j * \varepsilon ,$$

where $-\gamma A$ represents the difference in price elasticity between the two agency types

To test *H3*, which suggests that price transparency has a positive relationship with price elasticity, we compared the price elasticities of offline travel agencies and GDS-based OTAs. GDS-based OTAs have a higher price transparency measure than offline travel agencies, but a similar product transparency measure. In the context of the above model, $-\eta$ is the base price elasticity for *OFFLINE* and $-\gamma A$ captures the price elasticity of *GDSOTA* relative to *OFFLINE*. The estimated values of η, the base case price elasticity of demand for *OFFLINE* agencies, and γ, the dummy variable for *GDSOTA*, were negative and significant, with the following estimates: η = -0.68, SE = 0.06, $p < 0.01$; and γ = -0.46, SE = 0.01, $p < 0.01$. The estimates suggest that there is a price elasticity differential on the order of 0.46, with consumers in the GDSOTA channel being more price elastic than in the offline channel.

To test *H4*, which suggests that product transparency has a negative relationship with price elasticity, we compared the price elasticities of offline travel agencies and Hotwire. Offline travel agencies have a significantly higher measure of product transparency than Hotwire, while the price transparency measures are similar. In the context of the above model, η is the base price elasticity for *OFFLINE* and γA captures the price elasticity of *HOTWIRE* relative to *OFFLINE*. The estimated value η, which represents the base case elasticity of *OFFLINE*, was negative and significant (η = -0.91, SE = 0.01, $p < 0.01$). The estimated value of the differential φ between *OFFLINE* and *HOTWIRE* was 0.10, but it was not significant (φ = 0.10, SE = 0.07, $p < 0.16$). So we rejected the hypothesis that there is a difference between the price elasticity of *OFFLINE* and *HOTWIRE*.

In summary, we found support for the Price Transparency Proposition, which suggests that price transparency has a negative effect on consumer's willingness-to-pay. In particular, we found that price transparency decreases consumer demand and increases the price elasticity of demand. We also found support for the Product Transparency Proposition, which suggests that product transparency increases consumers' willingness-to-pay. Though we found that product transparency increases consumer demand, we did not find support for the hypothesis that product transparency influences price elasticity. We next discuss the strategic implications for Internet-based selling.

VI. IMPLICATIONS FOR FIRM STRATEGY

With this study, we contribute to a body of literature that can be used by practitioners to manage the informational challenges of the Internet revolution. As an outcome of this research project, we have developed an economic model that derives the prices and transparency levels that a seller should adopt to maximize profits (Granados, et al., 2005). This model suggests that if market transparency affects consumers' willingness-to-pay, firms should price relative to their level of market transparency to maximize profits. For example, we found that there is revenue opportunity in airline pricing by price-differentiating Internet versus traditional offline channels due to their different transparency levels. Combining the analytical and empirical results, we have derived the following guidelines for Internet-based sellers:

- A seller or distribution channel with a relatively higher *price transparency* level should

have lower prices.

- A seller or distribution channel with a relatively higher *product transparency* level should have higher prices.
- The development of *product-transparent selling mechanisms* will mitigate the negative impact of price decreases generated by Internet-enabled price transparency.

In closing, we note that differentiation with product information may be a valuable alternative in addition to traditional product differentiation strategies, because it can offset the negative effect of increases in the availability of price information. With this conclusion, we echo the perspective of Tapscott and Ticoll (2003), who argue in their book, *The Naked Corporation: How the Age of Transparency will Revolutionize Business*, that a transformation of organizational strategy and the marketplace is in the offing. Firms will make strategic choices relative to how "naked" they wish to be in product and price terms, and ultimately identify the business value and profitability limits of market transparency.

The tests of the impact of market transparency on price elasticity need further validation, because the differences in price elasticities across channels may be driven by channel-specific factors not controlled for in our econometric analysis. We also plan to perform controlled experiments to further test the impact of market transparency on consumers' economic behavior.

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